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CONTENTS.

CONTENTS.

CONTENTS.

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CONTENTS.

CONTENTS.

CONTENTS.

CONTENTS.

CONTENTS.

CONTENTS.

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CONTENTS.

CONTENTS

CONTENTS

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXXII. No. 1.

APRIL, 1925.

NOTES FOR THE MONTH.

Agricultural Policy.

In reply to questions in the House of Commons on 2nd March by Mr. MacKenzie Livingstone and Colonel Burton, the Minister of Agriculture and Fisheries, Mr. Edward Wood, made the following statement:—

"In view of the refusal of both of the Labour Unions to take part in the proposed conference of agricultural interests, the Government have come to the conclusion that it is impossible to establish a conference on the lines originally suggested. It was proposed by the Government in the hope that, if an agreement between the different sections of the industry could be attained, this might prove the foundation of an agreement between political parties as to a permanent national policy. The refusal of the Labour Unions to participate in the conference has destroyed this hope.

I have carefully considered the possibility of providing representation of farm workers other than from the two unions to which invitations were issued, but apart from the fact that such action would be unlikely to contribute to that political agreement which it was the main purpose of the suggested conference to secure, I am informed that in such an event the Council of the National Farmers' Union would withdraw their representatives.

In these circumstances it will be the duty of the Government, on their own responsibility, to frame such proposals for the assistance of agriculture as are consistent with the necessity of protecting the industry from the danger of sharp reversals of national policy, and with this end in view the Government propose, in accordance with their declared purpose of arriving at the greatest possible measure of agreement, to seek the co-operation of, and invite considered suggestions from the representatives of the different sections of the industry."

In accordance with the intention announced in the last part of the above statement, the Minister on 6th March addressed

(60395) P.6./R.4. 8,250. 4/25 M. & S. A

a letter to agricultural associations inviting them to forward considered suggestions, or, alternatively, he suggested that two or three representatives of the associaions should be appointed to discuss the question with him.

The associations to whom the invitation has been issued are: The Central Landowners' Association; the Land Union; the Land Agents' Society; the Surveyors' Institution; the Royal Agricultural Society; the Central Chamber of Agriculture; the Workers' Union; the National Union of Agricultural Workers; and the National Farmers' Union.

* * * * * *

Young Farmers' Clubs.

THE Ministry has taken over the supervision of the Young Farmers' Club movement, and has appointed an Inspector, who, assisted by the Woman Inspector, will endeavour to organise and co-ordinate the activities of the clubs and to give such supplementary aid as may be sought by local bodies who desire to extend the movement. The Ministry's Divisional Inspectors will also lend their aid to facilitate the provision of lectures and the dissemination of information by local authorities and educational institutions.

Those who are concerned with the furtherance of agricultural education, and who may have opportunities of promoting the establishment of Young Farmers' Clubs in suitable localities, will find helpful suggestions and information in the Ministry's Leaflet No. 103 which has recently been published.

Out of a total of 31 clubs originally promoted, 22 clubs are in active operation (20 in England, 1 in Wales, 1 in Scotland): 6 clubs, temporarily inactive, are being revived. The remaining 3 clubs closed down two years ago, but an endeavour is being made to resuscitate them. The membership totals 332 boys and girls, between the ages of 10 and 18 years.

The following list shows the kind of stock held by clubs :—

Calves	10 clubs.	Mixed (Calves, Pigs, Poultry, Bees, Apple trees)	1 club.
Rabbits	6 ,,	,, (Rabbits and Poultry)	1 ,,
Poultry	5 ,,	Ducks	1 ,,
Pigs	2 ,,		
Bees	2 ,,		
Horticultural ...	3 ,,		

The clubs have been promoted as follows :—

By Dairy Companies and others	18 clubs.	By Controller of Horticulture	1 club.
,, Private individuals	3 ,,	,, Agricultural Gazette	1 ,,
,, Schoolmasters...	3 ,,	,, Schoolmistress ...	1 ,,
,, Poultry experts	2 ,,	,, Boy Scout Local Association	1 ,,

By Breed Society, 1 club.

Most of the clubs have been recently visited, and in every case the keenness and enthusiasm of the members has been very marked. It was felt that a special effort should be made to enlist the sympathy and co-operation of societies interested in educational matters and bring prominently before the public the importance of this movement. Accordingly, the Ministry invited representatives of the Board of Education, the Royal Agricultural Society of England, the National Farmers' Union, the National Federation of Women's Institutes, County Education Authorities, County Agricultural Organisers, the Canadian National Railways and the United Dairies, Limited, to a conference with officers of the Ministry on 27th February. Mr. Dale, Assistant Secretary to the Ministry, presided.

The main features of the proceedings were :—

A brief survey was given of the present position of clubs, with a statement as to the reasons for their success or otherwise. With the exception of one girl who lost her swarm of bees owing to weather conditions, the members of all existing clubs are in a sound financial position. The 14 members of the Sussex Baby Beef Club made a net profit of £240 for the year ending 31st August, 1924. A balance of £50 in Lloyds Bank stands to the credit of 7 members of the Buckland (Buckingham) Mixed Club.

The capital necessary to start a club varies with the stock to be held :—

Approximately	£40 for a mixed club.
,,	£50—£100 for a Calf or Beef Club.
Up to	£20 for a Bee Club.
,,	£20 for a Poultry Club.
,,	£25 for a Pig Club.

The Ministry will not make grants or loans to start the clubs, but hopes that promoters will come forward and provide the capital required locally. Clubs ought to be self-supporting at the end of the first year. Hitherto no difficulty has arisen in regard to the question of capital. There will be a central policy directed from the Ministry for the guidance of the clubs, but of sufficient elasticity to meet local conditions. It will be the policy of the Ministry to invite the active co-operation of Local Education Authorities, and the Board of Education is in sympathy with the aims of the movement. The National Farmers' Union and the National Federation of Women's Institutes have both promised to assist. For the provision of technical advice and of occasional lectures it is hoped that the clubs may look to the County Agricultural Staffs and to the Provincial Colleges.

The hearty co-operation of the Boys' and Girls' Club Movement in the Dominions and the United States is assured, and International Cattle Judging Contests have been arranged.

Reference was made to the public-spirited work of companies such as the United Dairies and Milkal Limited, whose directors have done much to promote and foster the movement.

The work of the Ministry will be largely organisation, and interesting local people in the project.

Interest in the Young Farmers' Clubs is rapidly growing throughout the country, judging by the large number of inquiries addressed to the Ministry. No doubt club work will be a prominent feature of the educational system in every county, as it is likely to introduce boys and girls to new or improved agricultural methods at a receptive age and to awaken in them a readiness to test and adopt new ideas. In their time the young people will influence to some extent the outlook, and even the practice, of older people with whom they come into close contact. The movement is almost certain to lead more boys and girls to take advantage of the scheme of agricultural education provided by local authorities through organised courses of instruction or the courses established at Farm Institutes, and, indeed, there is some evidence to show that there have been such results already.

The experience of the United States of America, Canada and New Zealand is that this movement is instrumental in making better citizens, better homes, and in helping to promote and maintain rural life on a sound and economic basis.

* * * * * *

Disposal of Dairy Sewage.

WITH the growth of the factory system for the manufacture of cheese and other milk products in this country the disposal of dairy sewage presents a grave difficulty. In several instances in which the dairy effluent has been discharged into a river or stream there has been pollution, and local authorities have made application to the Ministry of Health for consent to the taking of legal proceedings under the Rivers Pollution Prevention Acts. Moreover, in some instances considerable damage has been caused to sewage disposal works by the discharge of excessive quantities of dairy effluent into the sewers of local authorities, and in other ways such effluent has given rise to a nuisance.

In Holland, where the country is very flat and the waterways are sluggish, the treatment of such waste waters is of vital importance, and in order to investigate the matter thoroughly, as well as to give the factories practical assistance in overcoming their difficulties in this direction, a Government Institute for the Purification of Waste Waters was established by a Royal Decree of 30th July, 1920.

The aim of this Institute is to conduct experimental work at the Institute and at factory installations with the object of preventing the pollution of water. In this way the Institute exercises a direct influence on the prevention of contamination of the waterways, and at the same time is kept fully informed of the difficulties encountered by individual factories.

A report of a deputation—consisting of representatives of the Ministries of Agriculture and Health and the National Association of Creamery Proprietors—which recently visited Holland for the purpose of investigating the methods adopted in that country for overcoming the dairy sewage problem, has been received by the Ministry and describes some of the systems. It shows that in making a comparison between the conditions in Holland as affecting the treatment of dairy wastes with those in this country, it would appear that theoretically the law against pollution is stronger in this country, but in actual practice the results of the administration of the law are much the same in both countries.

Local authorities in Holland generally require that whey, buttermilk or separated milk should not be discharged with the waste waters, and this requirement is generally met.

If whey could be as fully utilised in this country as it is in Holland, there would be no essential difference between the dairy refuse in this country and in Holland, and methods of purification which are applicable there would be applicable here. The discharge of whey along with the dairy effluent is undoubtedly the greatest source of trouble in this country, and if it could be avoided greater advantage could be taken of the natural purification effected by the more rapidly flowing streams of this country. At the present stage of the investigation into this problem, there does not appear to be any system which will deal efficiently for any reasonable period with undiluted whey or separated milk. The best means of dealing with such by-products is the natural one of feeding them to stock on the farm, but how far this can be arranged under the present factory system seems to be a question that has not been investigated up to the present.

The methods in use seen by the deputation are classed as follows: (1) dilution; (2) land treatment or irrigation; (3) lime precipitation followed by septic tanks and percolating filters; (4) activated sludge process.

Dilution was not generally found to be effective, even in the case of large canals, for although they are of large volume, they are almost stagnant and so do not afford sufficient dilution to be effective. Land treatment is only effective where a large area of suitable sandy soil is available. Percolating filters are effective if proper attention is given to their construction and management.

The activated sludge process was only being investigated on a laboratory scale at the date of the visit, and therefore could not be classed as one of the systems in actual practice. It is, however, understood that subsequent working scale experiments have been put into operation, and that they are very promising. It is to be hoped that the results of these experiments will be forthcoming at a later date.

It would appear that if any systematic investigation of this problem is to be undertaken in this country, it can only be done effectively by the establishment of an Institution on the lines of the Government Institute for the Purification of Waste Waters already established in Holland. This is a very vital question for the dairy and other industries in this country, and no effort should be spared in endeavouring to solve the problems which it presents.

* * * * * *

Report of the Committee on Foot-and-Mouth Disease.

THE Departmental Committee appointed by the Minister in February, 1924, and consisting of the Rt. Hon. E. G. Pretyman (Chairman), Sir W. Bromley-Davenport, K.C.B., and Messrs. A. Batchelor, H. German, and W. R. Smith, which inquired into the circumstances of the serious outbreak of foot-and-mouth disease which occurred during 1923 and 1924, has now issued its Report.

The Report, which is signed by all the members, traces the causes which led to the extraordinary development of the disease, with special reference to the circumstances attaching to the introduction and spread of disease in Cheshire.

It contains a number of important conclusions and recommendations with regard to the policy of the Ministry in dealing with outbreaks of the disease; the manner in which that policy

* Cmd. 2350, to be obtained either direct from H.M. Stationery Office, price 1s. 6d., or through a bookseller.

has been carried out by the Ministry and Local Authorities; precautions against the introduction and spread of the disease; compensation for slaughter; restrictions on the movement of animals and persons; and insurance, both compulsory and voluntary.

The Report cannot fail to be of interest to all who are in any way connected with the administration of the Diseases of Animals Acts, whether as members or officials of Local Authorities, or as stock owners.

* * * * * *

Licensing of Stallions in Season 1925.

THE decline in horse breeding, as shown in the Agricultural Returns last June, when the number of stallions used for service was returned as 4,707 as compared with 5,459 in 1923, and the number of foals as 54,801 as compared with 66,323 in the previous year, is further emphasised by the records available to 21st March as to the number of stallions licensed by the Ministry for this season under the Horse Breeding Act, 1918.

While some further applications for licences may be received during the next three months the number issued to 21st March is only 1,414. The comparative figures at this date for the last three service seasons are 2,808 in 1922; 2,217 in 1923; and 1,664 in 1924.

After the close of the service season the Ministry will publish particulars, according to breeds, of the total number of licences issued, but the information so far available may be of interest to horse breeders :—

	No. of licences issued to 21st March.			
Service Season.	*1922.*	*1923.*	*1924.*	*1925.*
Shires	1,774	1,349	902	741
Other Heavy Horses ...	520	405	336	274
Light Stallions (including Ponies)	514	463	426	399
Total ...	2,808	2,217	1,664	1,414

* * * * * *

The "De Vecchis" Beet Sugar Process.

The process invented by Dr. de Vecchis for the manufacture of beet sugar was brought to the notice of the Ministry in 1924. The process employs the principle of desiccation, and the economies which might result in the manufacture of sugar were obvious if the claims made on behalf of the process could be sustained. The reports which came to the Ministry from various sources were, however, conflicting, and in order to obtain an authoritative and independent opinion a Commission of Inquiry was appointed and sent to Italy. The Commissioners were Mr. John Bowden, M.I.C.E., M.I.Mech.E., late Chief Superintendent of H.M. Ordnance Factories, Woolwich Arsenal; Dr. William Goodwin, Advisory Chemist, South-Eastern Agricultural College, Wye; and Dr. B. J. Owen, Director of the Institute of Agricultural Engineering, Oxford. The Report of the Commission, of which the following paragraphs are a summary, has now been published.*

The industrial extraction of sugar from beet is most generally effected by the diffusion process, in which fresh beets after washing are sliced into cossettes and treated in suitable vessels with warm water, in volume sufficient to bring about the diffusion of the saccharine juice contained in the beet cells. This juice is afterwards purified and filtered. The resulting clear thin juice is concentrated by evaporation until sugar crystals form. Molasses are separated from the raw sugar crystals by centrifugal action, the sugar is refined and put up into marketable form, and the molasses are either sold as such or subjected to a further process by which other products are extracted.

In the De Vecchis process the fresh beets are washed, sliced into cossettes and desiccated in a drying apparatus in which the moisture of the fresh beet is reduced from 80 per cent. to 3 per cent.; desiccation is continued until the membrane of the sugar-containing cells is ruptured, and the albuminoid and pectic matter coagulated. The cossettes, as they leave the drier, are rigid and horny and have about 25 per cent. of the weight of fresh beet. In this condition they can be kept in suitable store rooms for several months without fermentation or loss of sugar. The sugar is extracted from the dry cossettes by washing with warm water. This process produces a juice

* Cmd. 2343, to be obtained from H. M. Stationery Office or through any bookseller, price 9d.

high in sugar content and free from the flocculent albuminoid and pectic matter. Without further treatment by evaporation, the juice (as in the diffusion process) is boiled and cooled, and the raw sugar separated from the molasses. The refining of the raw sugar into white sugar suitable for the market, and the treatment or disposal of molasses follow on the same lines as in the diffusion process.

Raw sugar was produced at the Loreo factory during the visit of the Commission, although the plant has not yet reached a stage of regular operation, mainly owing to the unsatisfactory desiccating apparatus employed. The conditions are as yet too unstable for the cost to be verified. The possibilities of the De Vecchis process were amply demonstrated, and after careful consideration of the plant and conditions at Loreo the Commission came to the conclusion that if worked with modern machinery the cost of producing sugar by this process would be no more, and probably less, than by the diffusion process.

The process has scarcely yet emerged from the experimental stage, but the principles appear to be sound and the improvements in the plant necessary to render it commercially successful ought to present little difficulty. Once these difficulties are overcome the process would present very great possibilities for the development of the sugar beet industry in this country. Conditions in England may differ in certain details from those in Italy, and the costs of production claimed for the De Vecchis process would need to be verified in actual operation here before any encouragement were given to its adoption by the sugar beet interests in this country. The process appears to be suitable to districts where the acreage under beet is small and widely scattered, and from which the annual production would be insufficient or the distance for transport too great to justify the outlay on a diffusion factory. It should, therefore, appeal to co-operative societies of small growers or to local trading groups. There is, however, reason to believe that the system could be made to apply to large scale production, since the desiccated cossettes can be treated by the equipment common to a diffusion factory. This offers the advantage of employing the factory for a greater part of the year than is now possible. The practice of desiccating beets suggests the possibility of installing drying plants suitable for small groups of farmers by means of which beet could be dried before transport to the factory.

The Commission came to the conclusion that while the principles of the De Vecchis system were technically sound, the question of their practical application was an open one, and that until reliable costings of the De Vecchis process, working on a satisfactory industrial basis, are available, it is not possible to say whether the claims made for the system would be realisable in practice. The Commission, however, thought the system sufficiently promising to justify further experimental work, and they made the following recommendations:—

(1) A complete plant of small capacity, but on a factory basis, should be set up in England by which the De Vecchis process may be tested experimentally. The experimental plant should incorporate such improvements as to secure efficient desiccation and defecation.

(2) Experiments should be undertaken to devise a complete cleaning, slicing and desiccating equipment of a capacity suitable for operation by the beet grower.

The question of carrying out experimental work on the lines suggested by the Commission is receiving the consideration of the Ministry, and a public announcement will be made when a decision is reached.

* * * * * *

The Sale of "Red Clover."

IN the report on the working of the Seeds Act, 1920, during the 1922-23 season which appeared in this *Journal* in December, 1923 (pp. 822-829) reference was made to the undesirable but very prevalent practice of selling Red Clover under a multiplicity of names such as "Red Clover," "Cowgrass," "Single Cut Cowgrass," "Perennial Red," "Giant Hybrid Cowgrass," "Late Flowering Red," "Common Red," "Broad-leaved Red," etc. This point is further developed by Professor R. G. Stapledon in his article, "Nomenclature of Grasses and Clovers," which appeared in this *Journal* in May, 1924 (pp. 156-161). It is therefore interesting to note in the new season's catalogues of some of the leading seed merchants announcements that they intend in future to describe their red clovers under the early-flowering and late-flowering groups, and to discontinue the use of such terms as "English Cowgrass," "Giant Cowgrass," "Mammoth Cowgrass," etc. This is a move in the right direction, and it is hoped that it will be followed by all the seedsmen in the country. It cannot be too frequently emphasised that there are only two groups of cultivated red clovers: one, which it is suggested should be described simply as "Broad Red Clover," being the

kind favoured for its production of spring and winter growth, of short-lived duration and most suitable for use in short leys; and the other, which should be known simply as "Late-flowering Red Clover," a more persistent variety and therefore most useful for long duration leys or for permanent pastures. It is true that there are numerous types in both of these groups. For instance, there is the "Montgomery Red" and the "Cornish Marl," both having extra lateness and persistency as a characteristic, but these are natural selections of the late-flowering group and should be described as such, although in two such special types as these, it might be desirable to add the more specific names in brackets, for the guidance of those who particularly need an extra-late-flowering clover.

* * * * * *

Export Trade in Horses.

THE Minister of Agriculture and Fisheries appointed, early in March, a Committee to inquire into the conditions of the export trade in horses from Great Britain to the Continent, and to advise whether, having regard to the necessity of ascertaining that no avoidable suffering is inflicted on such horses, any further restrictions should be imposed on the trade.

The Committee is composed as follows: Major J. W. Hills (Chairman); Sir Merrik Burrell, Bart., C.B.E.; the Lady Emmott, J.P.; the Marquess of Titchfield, M.P.; the Earl of Haddington, M.C.; the Hon. E. A. St. Aubyn Harney, M.P.; Arthur Hayday, Esq., M.P.; Major F. T. G. Hobday, C.M.G., F.R.C.V.S.; Mr. H. H. Miller, of the Ministry of Agriculture and Fisheries, is Secretary of the Committee.

* * * * * *

Farm Workers' Wages.

THE duty imposed upon the Agricultural Wages Committees of fixing minimum rates of wages for all classes of workers employed in agriculture has now been completed so far as male workers are concerned, by the making of the necessary Orders by the Agricultural Wages Board to cover such workers in all areas. Particulars of the Orders made since the March issue of the *Journal*, are given on p. 86. This marks a definite stage in the work of the Committees and, inasmuch as it has not been necessary for the Agricultural Wages Board to fix any rates in default of the Committees reflects great credit not only upon the wisdom and tact of the Chairmen and impartial members of the Committees, but upon the conciliatory manner in which the members

representing employers and workers have dealt with very controversial questions.

A point of particular interest to the farmer is as to how far the rates now operative are stable rates upon which he may budget for the coming six or twelve months. The date of termination of the rates in each area has been given in the *Journal* as each Order has been made, but it is instructive at this stage to see the general trend of the Agricultural Wages Committees' decisions in this matter. In six areas the rates now fixed will operate for twelve months, and in six others no date of termination has been fixed. The most general period is until September or October next, and this has been adopted by 17 Committees. In three areas the present rates will expire in November; in two in December, and in one in January, 1926, the remaining areas being covered by short period Orders which will need to be replaced by fresh Orders at a fairly early date. Thus it will be seen that in 35 of the 47 Agricultural Wages Committee areas minimum rates for the whole of the coming summer are now in operation.

* * * * * *

National Survey of Markets.

THE Ministry has addressed to Town Clerks and Clerks to County Councils an inquiry as to what customary markets, fairs, wool auctions, or other periodical assemblies of buyers and sellers of agricultural produce are held in England and Wales. Preliminary information is requested on the following points :—

(*a*) The names and location of the markets held in the area concerned ;
(*b*) the type of market in each case, i.e., whether controlled by a local authority or privately ; whether and, if so, to what extent wholesale or retail, and how often held ; and
(*c*) to whom communications in regard to the markets referred to in (*a*) should be addressed.

This inquiry arises from the following recommendation contained in paragraph 100 of the Final Report of the Departmental Committee (known as the Linlithgow Committee) on the Distribution and Prices of Agricultural Produce (Cmd. 2008) :—

" During the course of our inquiry, we have been struck by the " lack of readily available information regarding the markets of the " country. . . . As a preliminary step to the further consideration " of this question, we think it desirable that the Government Depart- " ments concerned shall collect and publish information as to the " control and ownership of markets, and any relative information likely " to be useful."

THE IMPROVEMENT OF VERY POOR PASTURES BY PLOUGHING AND IMMEDIATE RE-SEEDING.

PROFESSOR R. G. STAPLEDON, M.B.E., M.A.,
Welsh Plant Breeding Station, Aberystwyth.

THE Welsh Plant Breeding Station has an experimental farm of about ninety-six acres, the greater part of which is devoted to small scale plot trials. On this farm grazing has to be found for four working horses during the summer, and all the year round for a flock of sheep, upon which to draw for experimental grazing on plots devoted to various purposes. In order to ensure the provision of maximum grazing from fields unsuitable for critical field experiments it was therefore decided soon after taking possession of the farm to make every endeavour to convert all such fields which were in permanent grass or in out-run leys into high-grade temporary grass, the ultimate aim being to have on the farm no single field in permanent grass or under a ley of poor quality.*

It has been sought as far as possible to give an experimental character to the work of conversion; the sowing out has always been done on a plot basis and careful records have been kept of the cultural operations, and of the nature of the swards achieved, while early last year a system was initiated of registering the grazing from all the separate enclosures on the farm in terms of "sheep days."

In the main the plan adopted has been to plough the old sward and sow a seeds mixture almost immediately, either under a first and only corn crop, under rape, or without a nurse crop, and generally the large numbers of farmers visiting the station have been more struck by the palpable excellence of these swards, and, to them, the incredibly short time in which they have been established, than by any other aspect of the work in progress at the station. It is proposed in this article to give fairly complete particulars with reference to one of the most interesting fields, since it is felt that this information will be of value, not only to those who occupy farms in Wales that consist predominantly of inferior grass land, but also to graziers in general who are faced with the problem of how to improve fields of almost negligible grazing value in the shortest possible time.

* Areas obviously too water logged or too heavy to allow of even occasional ploughing, and those also which are too shallow and too steep for the plough, are regarded, and not without reason, as being unworthy of remaining in grass and are being planted with Sitka spruce and larch respectively.

The Field.—The experiment to be described was conducted in the Spring Field, a field with a north-easterly aspect, and on a very steep gradient, but not too steep, it was thought, to justify occasional ploughing. The soil was decidedly shallow, light and stony. The field had evidently been under the plough at some period in the past, since the marks of the open furrows were unmistakable. It is known, however, that the field had been under grass since 1909, and had received no treatment, manurial or otherwise, since that date, and such evidence as is available renders it highly probable that it was let down to grass upwards of twenty years ago. Botanical analyses were made on some of the very best portions of the sward during February, 1923.* The composition of the herbage on these relatively " good " portions was as follows :—

	per cent.
Bent (*Agrostis vulgaris*)	58
Crested Dog's Tail	11
Yorkshire Fog and Sweet Vernal Grass ...	10
White Clover	6
Woodrush (*Luzula* spp.)	4
Twenty other species, representing five species of grasses, one legume, and fourteen miscellaneous herbs	11
	100

In this condition the field was of negligible grazing value and was considered little, if any, better than mountain grazing. It was difficult to keep a flock of sheep on the field for more than three or four days at a time, even during the height of the growing season, while during March and April it was always necessary to supplement the meagre grazing with hay. " Sheep day " evidence subsequently obtained on another field with a slightly better herbage shows on a conservative estimate, that the field under review would have hardly come up to Pryse Howell's estimate, based on a survey of a number of farms at an average elevation of 600 ft. above sea level, with a carrying capacity of 1.1 Welsh Mountain sheep per acre.†

Cultivation Operations Previous to and at the Time of Sowing.—It was desired to ascertain whether the field could be successfully resown without very careful and deep ploughing—consequently, and with a view to expediting the work, it was tractor ploughed (one way) early in April, 1923. On the

* Twenty-six turves 6 in. x 6 in. were taken from carefully selected squares and these were analysed by the "percentage frequency" method by students as part of their practical work.

† Pryse Howell, J.: "The Productivity of Hill Farming," Oxford Institute for Research in Agricultural Economics, 1922.

basis of Cardiganshire war experiences with the tractor this would have been voted by most local farmers as an impossibility! It was necessary to leave wide headlands and these were horse ploughed. The contrast between the two methods of ploughing was very considerable—the body of the field under the tractor was very poorly ploughed—much too shallow, and the old turf was not properly buried. On the headlands the turf was completely buried under an adequate depth of soil. Harrowing was started early in May, and it was found impossible to break the soil down properly to anything approaching a reasonable depth (except on the headlands), chiefly owing to the fact that the top four inches of soil consisted almost entirely of a dense mass of roots. The final tilth was prepared by 18th May, on which date the experimental mixtures were sown. The average depth of the seed bed on the tractor area was about half an inch only and probably nowhere exceeded one inch. The seeds were sown on a dry day, covered with the chain harrow and rolled. Owing to the steepness of the field the rolling was, however, quite inadequate.

It will be apparent that the above conditions were far short of what ideally should have been aimed at for the purpose in view, and indeed the only conditions that were reasonably favourable for the establishment of the seeds were, first, that the soil was dry when the seeds were sown, and secondly, that subsequently showery weather intervened. It had been intended to apply basic slag at the time of sowing, but, owing to other pressing calls on the time of the men, this proved to be impossible. A dressing at a rate equivalent to 7 cwt. per acre of high-grade slag was, however, applied to the established sward in the second week of September, 1923.

Experimental Mixtures.—The field was divided into two approximately similar areas of about 1½ acres each, the areas being respectively sown with the mixtures shown below :—

	Area A. lb. per acre.	*Area B.* lb. per acre.
Rape	3	3
Italian Rye Grass	6	6
Indigenous Cocksfoot	13.5	—
Commercial Cocksfoot	—	13.5
Indigenous Tall Oat Grass .	3.5	—
Commercial Tall Oat Grass ...	—	3.5
Indigenous Tall Fescue ...	2.2	—
Commercial Tall Fescue ...	—	1.4
Montgomery Late Red Clover ...	4.5	—
Chilian Early Red Clover ...	—	4.5
Wild White Clover	1.0	—
White Dutch Clover	—	1.0

Early Establishment.—The difference between the horse-ploughed headlands and the body of the field (tractor area) was very striking as soon as the seeds began to braird, and indeed can still be seen (practically two years afterwards). On the body of the field, on which it must be insisted that the seeds were obviously not covered properly, the only species to establish itself really well was Italian rye grass—the red and white clovers established themselves only fairly satisfactorily, and the two cocksfoots eventually (although very slowly) established themselves in moderate quantity, although in a manner quite disproportionate to the amount of seed sown. Both the tall fescues were to all intents and purposes a complete failure. The tall oat grasses established themselves poorly, but appreciably, having regard to the smallness of the sowing of this large seeded species. The rape took but poorly and was disappointing throughout; no doubt this round seed, even more than the clovers, must be properly anchored to the ground in order that the seedlings may establish themselves.*

The above facts add emphasis to the absolute necessity of covering small seeds properly—a point which was convincingly demonstrated by Speir† some years ago, and quite recently by Williams. The evidence also suggests the futility of including in a seeds mixture, for sowing on poor land and on a poor tilth, species other than those known to have reasonably good powers of establishment, while even in the case of the species most likely to succeed, the desirability of adding to the seed rate in proportion to the poorness of the conditions is strikingly indicated.‡

* Trials on other areas have, however, clearly indicated that rape is unlikely to succeed particularly well unless the soil is in a fertile condition or unless manures have been freely applied.

† See Speir, John: "Depth at which grass seeds should be sown," Trans. High. and Agric. Soc. of Scotland, 5th Ser., Vol. V, 1895, p. 11. See R. D. Williams: "Depth of Sowing Grass and Clover Seeds," this *Journal*, Apr., 1922, p. 53, and May, 1922, p. 132; and "Methods of Covering Grass and Clover Seeds," *ibid.* March, 1923, p. 1125, and March, 1924, p. 1134. It is of interest to remark that although Capt. Williams was unaware of Speir's investigations at the time of conducting his own trials, nevertheless both authors in effect make the same recommendations, namely, "sow when the "soil is dry, sow on a harrowed surface, cover with a peg harrow and roll well "as the final operation."

‡ See Stapledon, R. G., and Jones, Rhoda: "Seed Mixtures for Temporary Grass: Investigations Conducted in Denmark and Sweden and Observations on Trials of a Similar Nature in Progress at Aberystwyth," *Welsh Journal of Agriculture*, Volume I, No. 1, page 60.

It is interesting to note that the behaviour of the species as indicated above coincides pretty closely with what would have been expected on the basis of both the Scandinavian investigations and critical trials now in progress at the

The Grazing Value of the New Swards.—In estimating the grazing value of the newly established swards, it is necessary to do so in relation to the following periods:—

(1) Late summer and autumn of the seeding year (1923).
(2) January, February, March and April of first harvest year (1924).
(3) May and April of first harvest year (1924).
(4) July and August " " "
(5) September and October " " "
(6) November and December " "

The two areas A and B were fenced separately, the original intention being to graze both plots uniformly during the first autumn and to obtain live weight increase data throughout the first harvest year. It was subsequently found impracticable to make the necessary sheep weighings, while the size of the plots was considered inadequate, and it was, therefore, decided to keep records in terms of "sheep days"; unfortunately, however, the sheep register was not started until January, 1924. During the whole of the first harvest year (1924) the plots were grazed with a control flock of Kerry Hill and Suffolk ewes (with or without their lambs according to season). The average weight of the ewes may be taken as about 130 lb. The plan adopted was to graze on an intermittent basis, putting a relatively large head of sheep on the plots (usually about 13-25) until they had practically cleared the herbage available and then resting the swards until the growth was sufficient to justify a further spell of hard grazing.*

Autumn of the Seeding Year.—Sheep were turned on the plots for the first time on 25th August, 1923, that is to say, a field of negligible grazing value had only been put out of action

Welsh Station. The outstanding ability of Italian Rye grass, and of Perennial Rye grass also, to establish themselves under unfavourable conditions, is undoubtedly one of the reasons and perhaps the chief reason—and a largely unsuspected reason—why the hill farmer and others operating on poor land adhere so tenaciously to large sowings of these grasses.

* It is beyond the scope of the present paper to discuss in detail the general applicability of this method of comparing the value of one sward with another, and it is obviously open to criticism from many points of view. It is a method, however, the ramifications of which it is intended to explore fully, and it is hoped to collect data which will make it possible to form a critical judgment alike as to its limitations and as to the uses to which it can legitimately be put—and looked at solely from this point of view the data presented in this paper are not without interest.

The following scale has been adopted with regard to converting lambs into sheep: For lambs dropped between March 10th and April 10th, one lamb equals, for the various grazing periods, the following fractions of a sheep:—May 1st-10th, 1/16th; May 11th-20th, 1/5th; May 21st-31st, 1/4th; June 1st-10th, 1/3rd; June 11th-20th, 1/3rd; June 21st-30th, ½; July 1st-10th, ½; July 11th-20th, ½; July 21st-31st, 2/3; August 1st-31st, 2/3; September 1st to December 31st, ¾. Owing to the shortage of grazing on the farm, horses had occasionally to be put on the plots, the conversion then used was—one horse grazing for 24 hours = 7 sheep, and grazing for a night only = 4 sheep

for a period of about three months, at least six weeks of that period being at a time of the year when the farmer normally has available almost more pasturage than he knows what to do with.

From the grazing point of view, the only species contributing to the herbage in appreciable amount during the autumnal period were the Italian rye grass, the rape (although a poor crop) and the red clover, and considering the smallness of the sowing the sward developed by the Italian rye grass in particular was at this time the outstanding feature of the field. The difference between the two plots was not very great, except for the fact that the Chilian red clover made more growth than the Montgomery. As the former would have contributed more keep than the Montgomery during the first autumn, it was in a sense more heavily grazed than the Montgomery during this period.

Unfortunately " sheep day " records were not kept during this period, but the ley provided an abundance of grazing until early November. Results from another experiment reported elsewhere give a measure of the achievement of Italian rye grass and red clover from 14th August to 31st October, showing an average carrying capacity of six mountain sheep per acre, making satisfactory live weight increases.* The ley under consideration was advisedly not grazed to its full capacity during the first autumn, but on a conservative estimate it probably carried approximately three of the Kerry Hill ewes per acre and could have been made to carry more.†

First Harvest Year.—*Botanical Evidence.*—Practically the only species contributing in really appreciable amount to the pasturage during the period January to April was Italian rye grass, and thus the grazing on the two plots was of precisely the same order. During May and June cocksfoot began to give a quite definite character to the herbage, but since botanical analyses showed that the indigenous and commercial

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* See Williams, R. D., "Winter Keep": *Welsh Journal of Agriculture*, Vol. I, 1924, p. 119.

† Perhaps an even better example of a field dealt with in the manner under review is afforded by a four acre field standing at about 900 feet above sea level at Blaentwrch, Farmers, Carmarthenshire. The field, which was steep, had not been under the plough for 35 years and was carrying a sward of negligible value. It took 15 days to plough the field, which was sown out on 17th June, 1924, with 10 lb. Italian rye grass and 8 lb. rape; 6 cwt. of 38 per cent. basic slag to the acre were applied on 28th May and 1 cwt. nitrate of soda on 18th July. Grazing commenced on 17th September, and from this date to 6th November, forty Welsh wether lambs were fattened. They were sold off at 34s. per head, their value being estimated at 24s. per head when turned on to the field. The field has maintained twenty-five store ewe lambs from 6th November last to 17th February, 1925.

strains were about equally distributed on their respective plots, it is not probable—particularly since Italian rye grass was still by far the most abundant grass—that the grazing of the plots was differentially affected by the fact that cocksfoot was represented by a different strain in each. By June, the plots showed a very decided difference in respect of the clovers. In the case of white clover, although the number of plants per unit of area was about the same for both white Dutch and wild white, the plot on which wild white had been sown showed a much denser and closer mat of white clover and had the appearance of providing actually the greater amount of herbage.

The greatest contrast was, however, between the red clovers, and this became considerably accentuated in July and August, during which period the Italian rye grass began to wane and the red clover for the first time became the dominating element in the grazing. The Montgomery plot was then manifestly throwing more red clover than that on which Chilian had been included. By September the wild white clover had fairly established itself and during this month both the white clover (particularly wild white clover), and red clover (particularly Montgomery) continued to provide probably the largest proportion of the grazing. In October and early November, Italian rye grass was again the chief element in the herbage, assisted to some extent by the clovers, cocksfoot, and such grasses as the fine leaved fescues and bent, which had come in again to a slight extent. By December daisies, ribgrass and cat's ear, also present in appreciable amount, were similarly contributing to the grazing taken by sheep.

Notes taken in February, 1925, that is to say, early in the second harvest year, showed Italian rye grass, although much thinned, still remarkably abundant on the plots, and still capable of growing quickly after grazing and once again contributing far more keep at this period than any other species. The wild white clover was well established and with very appreciable assistance from the Montgomery red and the cocksfoot it was quite evident that a sward infinitely superior to the original turf was assured for at least another three or four years, and probably for a considerably longer period. The plot on which white Dutch and Chilian red replaced wild white and Montgomery red does not look so promising, but it is apparent that on this plot a considerable amount of native and non-sown wild white has re-established itself, and it is

quite evident that it will take some years before the herbage even on this plot can revert to its original inferior character.

It is probable that the plot on which the wild white clover and Montgomery red were included was very slightly more favourably placed than the other. It was, however, noted at the time that Chilian red clover established itself quite as well as, and probably slightly better than the Montgomery: yet by October, 1924 (first harvest year), careful counts showed that there were over eight times as many plants of red clover per unit of area on the Montgomery red plot as on the Chilian red plot.* On sub-plots which had been grazed till March and then put up to hay the advantage was still with the Montgomery red, but on these hay plots the red clover was only three times as plentiful on the Montgomery as on the Chilian plots. The above facts, even if greatly exaggerated by soil differences,† afford striking confirmation of results obtained on small-scale plots repeatedly cut with a garden mowing machine, namely, that the extra late flowering red clovers stand heavy grazing altogether better than the early reds. Thus continued intermittent grazing from the moment of establishment of the ley had shown its effect to a far greater extent on the Chilian than on Montgomery red clover, and this effect still showed itself, although to a less degree, when heavy grazing was operative only during the first autumn and up to March of the first harvest year.

"Sheep Day" Evidence.—It will have been apparent from the above botanical description that the effective herbage on the two plots did not differ materially, except during late June, July and August, when the preponderance of red clover on the Montgomery plot undoubtedly had a considerable influence. In view of this, and the fact previously mentioned, that the two plots were apparently not quite equally placed as to soil, the "sheep day" results for the two plots have been averaged and give the carrying capacity of the ley as a whole (a three acre field), for the period 1st January to 31st December, 1924 (= the whole of the harvest year), as 2.9 adult—and for the district decidedly heavy—sheep per acre, compared to the previous capacity of the field which was certainly not more than 1.1 mountain sheep (of an average weight not exceeding 65 lb.) per acre.

* Based on eight readings (with a mesh 6 in. x 6 in.) on each of three representative squares.

† If the differences above noted had been solely due to soil irregularity, it would have been expected that the ratio of Montgomery to Chilian on the hay and pasture plots alike would have been about the same.

The average figures for the five periods in terms of sheep per acre were as follows:—

January-April	0.9
May and June	4.9
July and August	6.7
September and October	1.3
November and December ...	0.8

The above figures afford a striking commentary on the value of clovers, perhaps especially red clover, for summer grazing—the field actually attaining to its highest carrying capacity in July and August, a period when, ordinarily, grazing is not so plentiful as in May and June. The figures also indicate the great difficulties connected with providing herbaceous keep during the winter and early spring months. The better part of a large sheep to the acre maintained in health and without any hand feeding has, unfortunately, by comparison with the ordinary grass land of the district, to be regarded as eminently satisfactory. It should be emphasised that the "sheep days" recorded during the dead season on the ley were not "starvation" days. It was always noted that sheep turned on this or other rye grass areas were contented (of course only for a reasonable grazing period) and did not attempt to break fence, nor had they access to any appreciable area of hedge. On the ordinary permanent grass of the district it is quite impossible to retain sheep for more than a few hours at a time on a small enclosure during the winter, while the contribution made by hedges to the starvation ration afforded by such pastures must be very considerable.

General Conclusions and Recommendations.—From the particulars given as to the establishment of the seedlings it is obvious that when it is proposed to plough down a sward and immediately re-sow it with a view to producing an improved pasture, the ploughing should be deep and the turf completely buried, and every endeavour should be made to obtain a tilth of at least 2 in. in order to render it possible to cover the seeds properly. The question of the correct date for ploughing and also for sowing out is therefore important. It would in most cases be an advantage to plough earlier than April so that the old turf could be given more time to rot and the upturned soil more time to become weathered by natural processes. Within reason too the earlier the sowing out the better, so that the sown species may be given the longest possible time to establish themselves before a certain inevitable growth is made

by the old turf.* The practical objection to an earlier start is, of course, that under present systems of management every yard of winter grazing, no matter how intrinsically inferior, is regarded as of the greatest possible value.

Evidence from other trials very similar to the one here discussed lead to the almost irresistible conclusion that perhaps the chief factor making for the success of the undertaking is to apply basic slag in adequate amoünt, *just previous to, or at, the time of sowing*. On poor land there seems to be little doubt that slag incorporated properly in the soil does assist the seeds to establish themselves and hastens the formation of a sole to the sward more effectually than does an equally heavy dressing applied on the surface *after the seeds have taken*.

The last points to be insisted upon in connection with cultural operations (again drawing evidence from a number of trials) are, the desirability of sowing on a harrowed surface, of harrowing the seeds in with a peg-toothed harrow, and the importance of concluding with heavy rolling. Thus a dry soil and dry weather at the time of sowing are alike important.

It is evident, however, from the results given by the trial under review, that if conditions only sufficiently satisfactory to ensure a reasonable take of Italian rye grass, and but a moderate take of wild white clover,† can be achieved there is yet every prospect that a sward incomparably superior to the old turf will be produced in the course of but a few months.

The Italian rye grass may apparently be relied upon to provide good grazing until the wild white clover has fairly established itself, and until an improved semi-natural sward develops under the ameliorating influence of wild white clover.

It is not suggested that mixtures for this purpose should consist only of Italian rye grass and wild white clover, but it is suggested that such a mixture would be far more likely to be reasonably successful than a complete failure. It is further suggested that Italian rye grass and wild white clover should be regarded as the pivotal species around which all such mixtures should be drawn up, and particularly when due regard is paid to two further facts, namely, that Italian rye grass and wild white clover in their two very different ways are pre-eminent as suppressors of weeds—a very important matter when one sets out to conquer an old turf full of weeds—and that Italian rye

* It might be thought that the autumn would be a favourable season to undertake the work of conversion; trials now in progress at the station show conclusively that in West Wales, at all events, the sowing of small seeds even in August is attended with considerable risk, while to sow later is to court almost certain disaster.

†For under the combined influence of slag and abundance of bare ground wild white clover will rapidly compensate itself for an indifferent take.

grass is of outstanding value for providing winter and early spring keep.

Modifications in the mixture should first aim at putting the field out of action for as short a time as possible, and also assisting to provide winter keep. Thus there is much justice in Wibberley's* suggestion, although made in a somewhat different connection, that mustard and hardy green turnips might be introduced to replace the rape.

Further modifications should aim at providing as much keep as possible during the first harvest year, particularly when the Italian rye grass begins to wane, and the experiment under review has shown clearly that an extra late flowering red clover is superior to an early or broad red clover for this purpose, and this is substantiated by all the small scale trials bearing on the subject that have been so far conducted at the station. These have incidentally shown that of the earlies a good English strain is far superior to Chilian.†

Having regard to the cost of ploughing and other necessary cultivations the most important modifications to be made in the mixture must aim at assisting the wild white clover to form rapidly the counterpart of an excellent permanent sward that will continue productive for a considerable number of years.

Had the field under review been horse ploughed it could only have been ploughed one way, and one-third of an acre a day would have represented good work—thus it is doubtful if such a field could have been re-seeded with a reasonable mixture and adequately slagged under £6 per acre. The costs would of course be considerably reduced on less difficult fields; while in regard to all work of this sort it must always be remembered that the ploughing of old sward can be undertaken under weather conditions when normally horses would be idle and men would be performing bad weather jobs. Thus, in many cases it might with much justice be argued that the cost of ploughing would, in fact, be adequately met by a debit to cover a few ploughshares, insurance against employers' liability, and the whole or a part of the horseman's wage, according as to how economically he would otherwise have been employed.

Looked at from every point of view, however, it will be apparent that it will probably but seldom pay to break and re-sow a turf unless at least four, five or more years of greatly increased grazing can be assured—although in estimating the number of

* See "Spring and Summer Forage Crops" in *The Book of Dunns' Farm Seeds*, Salisbury, 1925.

† See e.g. R. D. Williams: "The Productivity of Different Strains and Nationalities of Red Clover under Hay and Pasture Conditions," *Welsh Plant Breeding Station*, Bulletin Series H., No. 3.

years of good sward that must be obtained to constitute a paying proposition it must be remembered that increased autumn, winter and early spring grazing has an altogether greater value than increased late spring and summer grazing.

Evidence from trials in progress at the station suggests three* species in particular which can be relied upon to assist wild white clover to make a permanent sward rapidly, namely, rough-stalked meadow grass, crested dog's tail and indigenous perennial rye grass—and all of these species when fairly established exert a decided influence on the grazing available during the dead season.

It is not improbable that "ex Wild White" perennial rye grass in cases where the seed has in fact been taken off genuine old permanent pastures might alone and unaided be competent to give the necessary assistance to wild white clover. Until further trials with the commercial seed of this rye grass, now to a limited extent finding its way on to the market, have been conducted it would, however, be wiser, particularly in regions of high rainfall, to place at least a measure of reliance on crested dog's tail for the poorest soils and on rough-stalked meadow grass for poor and good soils alike.

To conclude, and acting on the very reasonable assumption that the farmer is both able and willing to experiment for himself, the writer may perhaps be permitted to suggest the basis on which a mixture for the purposes under review should be drawn up. The following mixture, per acre, with alternatives, is put forward on the assumption that the field will be grazed for the first time about 6, 8, or 10 weeks after sowing, and will be used thereafter only as a pasture :—

	lb. per acre.	
Mustard	5	or rape 5 lb.
Hardy Green Turnips ...	2	
Italian Rye Grass	6-8	or 12 lb. if rough-stalked meadow grass and crested dog's tail are excluded.
Indigenous Perennial Rye Grass	6-8	
Rough-stalked Meadow Grass*	3	or 1½ or 2 lb. of each of these species.
or		
Crested Dog's Tail* ...	3	
Montgomery or Cornish Marl (extra late) Red Clover ...	6	The viability of these strains is generally rather low.
Wild White Clover ...	1-3	According to degree of excellence of "take" prognosticated.

* It is of some significance to note that the ordinary commercial seed of rough-stalked meadow grass and crested dog's tail does not give rise to plants differing so profoundly from true indigenous seed as is the case for instance with perennial rye grass, cocksfoot and timothy.

The experiment under review certainly suggested that for poor conditions of soil and tilth the seed rates therein adopted, even for Italian rye grass and wild white clover (successful as they were), were hardly sufficient. To be too sparing in the two pivotal ingredients would be to jeopardise the whole success of the undertaking. It must also be remembered on the one hand that the viability of the genuine Montgomery and Cornish Marl red clovers is usually considerably lower than that of Eastern Counties or foreign red clovers, and on the other hand that the powers of establishment of crested dog's tail and rough-stalked meadow grass are not particularly good, even though the viability of the seed may be excellent.

The writer is indebted to his colleagues, Capt. Williams, B.Sc., Mr. Martin Jones, B.Sc., and Mr. William Davies, B.Sc., for invaluable assistance in the conduct of the experiment and in the preparation of the data on which this article has been based.

* * * * * *

ENSILAGE.—V.

STACK SILAGE.

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STACK silage, like clamp silage, can be made without capital expenditure, nor is any preparation such as the excavation of the pit for clamp silage, generally necessary. The method can. therefore, be brought into operation at a moment's notice, as. for example, when a crop has been cut for hay and partially spoilt by rain Such a case occurred on the University Farm at Cambridge in 1924, when a partially spoilt crop of clover and ryegrass was converted into a useful stack of silage. In the same way second crops of seeds or grass at the end of summer may be converted into valuable fodder by this method, in weather totally unsuited to hay-making. Wibberley even claims to have demonstrated that a crop of mustard can be made into good silage in the stack, whereas this crop is not suitable for silage making in the clamp or in the tower silo. All these are emphatic advantages, but, as will be shown later, stack silage, unless made on a very large scale, is liable to be associated with excessive wastage by moulding on the outside.

Stack silage by reason of its exposure to air and the difficulty of thorough consolidation, favours rapid fermentation which, though producing sweet, palatable silage, may lead to excessive loss of food material during fermentation. Another consequence of such rapid fermentation, especially when irregularly distributed in the stack, is the tendency of the stack to settle irregularly and possibly to slip or overturn.

Building the Stack.—The position of the stack should be chosen both in relation to the field where the crop is grown and the use of the silage. The stack should be rectangular with rounded corners; angular corners cannot be kept sufficiently compact to prevent access of air and moulding. The dimensions should be as large as the crop to be ensiled justifies; a single large stack is preferable to two smaller ones, because it entails a relatively smaller proportion of outside exposed, and therefore less wastage. The floor of the stack, so long as it is not situated in a hollow into which water might drain, requires no layer of straw, since if dry straw or other porous material is used it tends to admit air and the silage in contact with it moulds. The silage crop is therefore stacked directly upon the earth floor.

The danger of producing sour silage at the bottom, so common in clamp silos, is not very great, but if the crop is very green and succulent it may be desirable to build the floor of slightly dried crop or to give the bottom of the stack (4-5 ft. high) a couple of days to heat before proceeding. Except in the above-mentioned case, and especially as building proceeds, the tendency will be for the temperature to rise excessively; this should be counteracted by efficient trampling when stacking the freshly-cut crop, and by stacking as fast as the settling of the stack allows.

Some makers of stack silage advocate the sprinkling of common salt over the stack whilst building proceeds, to reduce the intensity of this heating. Wibberley advocates the pouring of brine solution into a stack that is heating excessively, but the writer has no experience of either of these methods.

The walls of the stack should be almost vertical or very slightly drawn in as the stack is built, so that when the stack is complete and has settled there shall be a steep slope downwards over which the greater part of the rainwater will be shed. It is not good practice to allow the eaves to project as in a corn or hay stack, because the angles at the eaves would become completely mouldy owing to the impossibility of compressing

them sufficiently to exclude the air. During the building of the first half of the stack the centre should be kept only slightly " heartened " so that there may be no tendency for the sides of the stack to slip off; in the building of the latter part, however, every effort must be made to raise the centre so that the roof may have a considerable slope for the shedding of rainwater. The actual building of the stack is very heavy work, and where possible it should always be lightened by the use of an elevator or horse fork.

Settling of the Stack.—One of the difficulties of making stack silage is due to the fact that the stack as it heats settles enormously: the following records of a stack made at Cambridge in 1924, for which I am indebted to Mr. F. H. Hanley, B.A., will illustrate this point:—

June 9th.	Stack begun and reached 8 ft. 6 in.
June 10th.	Stack settled to 6 ft. and then stacked to 14 ft.
June 12th.	Stack settled to 8 ft. and then stacked to 14 ft.
June 13th.	Stack settled to 10 ft. and then stacked to 16 ft.
June 14th.	Stack settled to 14 ft. 6 in. and then stacked to 17 ft. 6 in.
June 18th.	Stack settled to 9 ft. and then stacked to 16 ft.
June 20th.	Stack settled to 13 ft.
July 14th.	Stacked settled to 9 ft. 6 in.
Dec. 31st.	Stacked settled to 7 ft. 6 in.

The heating and settling should be uniform, but the stack heats and settles irregularly if under the influence of continuous wind in one direction, and difficulties in adding to the height of the stack arise. Remembering that this irregular heating is generally due to continuous wind pressure driving the air into the stack on the windward side, and thus driving the heat to the leeward side, it is possible to counteract the difficulty by hanging a sailcloth along the windward side. This practice has been adopted on two separate occasions at Cambridge with silage stacks having a very dangerous lean, and in each case with the result that heat was generated on the windward side, and this settled so that the stack righted itself. The use of a sailcloth in the case of hay stacks which tend to overheat and settle unevenly is also worthy of consideration. Another method helpful in righting a leaning stack of silage consists in weighting the top of the stack on the windward side with sleepers or other weights to assist in the consolidation and settling on that side.

Covering and Pressing.—The most difficult part of the process of making stack silage is the covering and pressing.

If neither is done, then in a humid climate, especially when the stack is kept for six months, the wastage is excessive. It is not generally possible to cover the stack with earth like a clamp silo, because of the great labour of excavating the soil and elevating it, though Wibberley has described* the use of the horse fork or pitch pole elevator for this purpose, using a box on the haulage rope to carry the soil instead of the fork.

Wibberley has also recommended the practice of building a straw stack or hay stack on top of the silage stack, but the obvious objections to this are that the material may not be available at the time, and that the two stacks may not be required for use at the same time.

During the first silage boom in the 'eighties, many devices were utilised for the purpose of pressing stacks, with more or less success. An example of one of the best of these is still in use on the Reading sewage farm, where stacks of rye grass silage are annually made. In this case the pressure is exerted by means of windlasses. Parallel oak beams are placed at distances of 30 in. apart across the floor of the stack, which is built upon them, leaving the ends exposed. The windlasses are attached to these exposed ends. After the stack is completed stout poles are placed horizontally along the ridge, the middle of the roof, and the eaves to take the bearing of wire hawsers which are passed over the roof at right angles with these bearers. Each hawser is attached to a windlass on either side. The operation of the windlasses draws the wire hawsers tight, from which the pressure is distributed through the poles over the stack at the will of the operator, and these hawsers are tightened from time to time as the stack settles. This is a successful method of pressing a silage stack, but entails capital expenditure upon windlasses, etc. This description of pressing stack silage is given, not for the purpose of advocating its general adoption, but to illustrate one successful method, and to point the way for other possible modifications of the plan.

At Cambridge in 1924 an attempt was made to copy this method, but in place of the windlasses bags of soil and sleepers tied to fence wires were used; the wires were passed over the stack in like manner to the wire hawsers, resting upon parallel poles on the roof, but the method was not successful; the weights rested against the sides of the stack instead of hanging clear,

* This *Journal*, Sept., 1916: "Sweet Stack Silage," T. Wibberley.

and so failed to exert their full pressure, and mould penetrated into the roof of the stack badly.

Wastage.—Reference has previously been made to the great loss which may occur in silage stacks, especially when made on a small scale. This is illustrated in the case of the stack made at Cambridge in June, 1924. The stack was 16½ ft. wide and 27 ft. long, and in August when the stack was first cut, it was between 8 and 9 ft. high. The crop consisted mainly of Italian rye grass and clover originally cut for hay, which was washed by rain for a week while lying in the field before stacking as silage. The conditions for pressing the stack were unsatisfactory; in fact the highest temperature amounted in one place to 173 deg. F., and the very wet season contributed greatly to spoiling the exposed portions. Weighings of the amount of wastage by moulding on the roof, sides and floor were made on 23rd September, and again on 8th December. On the former occasion the waste amounted to 29 per cent., and on the latter to 35 per cent., in addition to fermentation losses amounting to an average of 10 per cent. of the good silage remaining. It is true that the resulting silage was very sweet and palatable, and that the crop as hay would in all probability have been completely spoilt by the rain. Nevertheless, although the losses were accentuated by inadequate pressure, the fact remains that they were enormous.

The conclusion to be drawn is, I think, that whilst stack silage may be a useful practice in exceptional conditions as, for example, in bad haymaking seasons, or of crops late in summer, it is not a practice to be recommended for general adoption.

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THE DOWNY MILDEW OF THE HOP.—II.

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Epidemic Occurrence in England in 1924.—Previous to 1924, the Downy Mildew of the hop had been recorded from one place only in Europe, viz., in the experimental hop garden at Wye College. During the summer of 1924, the fungus was found at the Fruit and Hop Research Station, East Malling, Kent, on some young hop plants, the cuttings of which had been obtained from Wye College in 1922-23, and grown in a nursery bed during 1923. All these plants (which had been kept isolated during 1924) whether diseased or healthy, were promptly grubbed up and burnt. Later in the summer, the disease was found in the nursery bed of hop cuttings and sets at East Malling, and the whole stock of several thousand plants was burnt.

In 1923 cuttings of other plants had been raised at East Malling in the same nursery bed alongside those received from Wye, and the former had been distributed to hop growers during the winter of 1923-24. It became necessary to visit all the farms where these hops had been planted and inspect them. Consequently the farms concerned. viz., 20 in Kent, 2 in Sussex and 1 each in Hampshire, Worcestershire and Herefordshire, were visited. The disease was found on the hops sent out from East Malling Research Station in the following cases: Kent, 16 farms; Sussex, 2 farms. On the remaining farms in Kent, and on those in Hampshire, Worcestershire and Herefordshire the disease was not found. In some cases in Kent the hops had been planted out in the farmer's hop garden, and here the fungus was found on plants adjoining those obtained from the research station. Thus at Horsmonden, the fungus was found on several hills of Fuggles, and at Paddock Wood, on Tutshams. In some instances cuttings taken from quite healthy rows of hops had been sent out, and had been planted by the farmer in a nursery adjacent to cuttings taken from his own stock, and it was a surprise to find the Downy Mildew occurring to an equal extent on both sets of plants. Whilst in many cases the disease on the farms mentioned was probably due to its introduction on plants from the research station, it seems possible, in the light of knowledge acquired later, that in some of the cases the infection proceeded from another source—particularly where nettles or wild hops occurred in the immediate vicinity. At that time, however, the facts known warranted the belief that the Hop Downy Mildew had been intro-

duced into this country on imported plants, and that therefore it was imperative that all steps should be taken to stamp out the disease if that were possible. Consequently the farmers concerned were persuaded to destroy not only all the hop plants obtained from East Malling but also in some cases rows of hops in commercial hop gardens, and also some thousands of cuttings in nursery beds, which were, or might have been, contaminated. With the loyal co-operation of the farmers the destruction was secured not only of these plants, but also of those on the other farms mentioned above, which on close examination appeared to be healthy. It was eminently desirable that the destruction of these plants should take place; and even when the situation is reviewed with the help of knowledge gained later, it seems to have been the best course in view of the possibility that different forms of this fungus may exist, some of which may cause a more serious disease than others.

Later in the season the Downy Mildew was discovered in the experimental hop garden at East Malling Research Station, where new seedling varieties raised at Wye College are tested against the commercial varieties. The fungus was found both on the leaves and on the hop cones, and with a few varieties the latter were so severely affected that the crop was ruined.

At the end of September and during October fresh facts were discovered which threw an entirely new light on the subject. At the end of September a Downy Mildew was found by one of the writers on a wild hop in a roadside hedge at Westwell, near Ashford, Kent. This led to a general search being made, and during October the fungus was found on wild hops in the following parishes in Kent: Paddock Wood, East Peckham, Wateringbury, Selling, Hastingleigh, Hothfield, Addington, Pluckley, Egerton, and between Hothfield and Ashford. Mr. J. Amos, of the East Malling Research Station, also discovered the fungus on wild hops growing on the railway bank near East Malling Halt. Some of the localities mentioned above are so far distant from Wye as to make it highly improbable that the Downy Mildew on these wild hops in the hedges could have been derived from the experimental hop garden at Wye. It was, however, desirable to ascertain whether the fungus occurred on wild hops at a greater distance from commercial hop gardens than could be the case in Kent. One of the writers therefore visited Middlesex, and after a short search found, on waste ground at Twickenham, wild hops bearing the Downy Mildew on both the leaves and cones. Further confirmation was obtained in the following way; one of the writers

was aware of the existence of a wild hop growing in a hedge at Bickington, N. Devon; leaves from this plant were obtained, and were found to be infected by the Downy Mildew. Thus in two counties where hops are not cultivated, the fungus was found on the first hops examined. It can be regarded as proved then, that a Downy Mildew of the hop plant is certainly native to, and widely distributed in, this country.

A search was then made for the fungus in commercial hop gardens generally. At that time of the year (October) the hops had all been picked, and the bines, still bearing leaves, were either on the ground or hung over the breast wires. On the youngest of the leaves, or more rarely on the older leaves, small patches of the Downy Mildew bearing summer spores could be found. In a few cases the fungus was so abundant that the under-surface of the leaf was conspicuously blackened in places by the dense, sooty-violet patches. As a general rule, however, the patches were quite small and inconspicuous, and in no case was the infestation severe enough to have attracted the attention of any hop grower. Time permitted of the search being made in only a limited number of hop gardens, but it can be stated that in those of the district between Paddock Wood and Maidstone a general infestation occurred of the nature described above. The following are the parishes in which hop gardens containing the disease were found: Paddock Wood, East Peckham, Wateringbury, Boughton Aluph, Wye, Selling.

At one farm near Paddock Wood the fungus was found on the leaves among withered hops on the pulled-down bine. In this case it was reported to us by the farmer (an experienced hop grower) that some disease of a nature unknown to him had attacked the hop cones just before they were fit to pick, had rapidly turned them brown and completely ruined the crop. The farmer had cut the bines down over some acres, in order to prevent the disease spreading. Although no Downy Mildew was observable on the withered hops when the writers visited the farm in October, it appears possible that this was a case where a commercial hop garden in Kent had already suffered from attacks of this diseases.*

* Caution is needed in attributing the cause to the Downy Mildew, because in 1924 in this, as in other hop-growing countries, a disease apparently of a physiological nature and not due to any organism appeared on the ripening hop cones and discoloured them. It seems probable that this disease, which appeared in many parts of Kent, was caused by the persistent cold, wet weather, and is the same as that described on the Continent as "la maladie nouvelle," "la maladie des houblons de 1924" and "maladie rouge" in "*Le Petit Journal du Brasseur*," XXXII, Sept. 19, 26, Oct. 10 (1924).

Visits were then made to farms where cuttings of commercial varieties of hops are raised by the thousand in nursery beds and then sold. Nurseries were inspected at Malling, Boughton Aluph, Wye and Selling, and in every case the plants were found to be more or less heavily infested with the Downy Mildew. Thus at Boughton Aluph practically all the plants (rooted sets of a Golding variety) bore numerous patches of the mildew on their leaves; at Wye and Selling the sets of Bramling, Tutshams, etc., were similarly infected. In the case of some of these nurseries the sets were already sold, and will have been distributed during the past winter to hop growers not only in Kent, but also in Surrey, Hampshire, Worcestershire and Herefordshire. In one such instance it is not too much to say that every plant was more or less affected with the Downy Mildew. The injury to the leaves was negligible, and the disease under the circumstances would be passed over by the average practical man; on the attention of the grower being called to the spotting of the leaves caused by the disease, it was dismissed by him as being nothing new, of no importance and due to the natural "ripening off" of the plants. There is the probability therefore that every batch of plants sent out from this nursery (as well as from others) has carried winter spores in the soil attached to the roots, either in fragments of leaves or free in the soil. The possibility also exists that the fungus may have been transported in the form of spawn in the stem or in its buds.

Leaves of hop sets from nurseries on various farms in the Weald of Kent and in Herefordshire were also examined and found to bear the Downy Mildew.

On the greater number of the farms mentioned above, where the Downy Mildew was found in commercial hop gardens or in nurseries, no hops from either Wye or East Malling Research Station had been planted, and it was quite certain that the disease had not been introduced from either place but was occurring spontaneously. Certain facts observed on the farms visited, and elsewhere, gradually led the writers to suspect that the source of the disease existed in a very unexpected quarter. A Downy Mildew attacking nettles has long been known in this country, and during the wet autumn of 1924 was extremely prevalent in Kent, both on the Perennial Nettle (*Urtica dioica*) and on the Annual Nettle (*U. urens*). Leaves attacked by this fungus show dark angular spots similar to those caused on the hop leaf (compare Figs. 8 and 9). In the hedges surrounding Kent hop

gardens, and in most hop nurseries, nettles of both the perennial and the annual kind occurred in abundance, and it was a comparatively rare occurrence to find nettles free from the attacks of the Nettle Downy Mildew. A suspicion that the Nettle might be concerned in the sudden appearance of a Downy Mildew on the hop was strengthened by the fact that it was by no means an uncommon occurrence to find nettles bearing the Downy Mildew in the closest proximity to hop plants, both in nurseries and in roadside hedges. Sometimes the stem of the hop was twining round the nettle stem, and in one such case the hop plant was also affected with a Downy Mildew, the other hop plants near-by being healthy.

Under the microscope the Downy Mildew of the hop was found to be identical in structure with that on the nettle, except that the winter spore (*oospore*) of the former was slightly larger.

Attempts were made to establish the identity of the two Downy Mildews by making cross-inoculations, *i.e.*, taking the fungus from the hop and putting it on the nettle, and vice versa. Although the season was late for such work, and there was scanty time for obtaining the most suitable plants, the results of the experiments (which are published elsewhere in detail*) appear to show that the Downy Mildew of the hop can infect the nettle. Of 45 leaves of the annual nettle which were inoculated with summer spores of the Downy Mildew taken from the hop, six leaves became infected; of 27 leaves of the perennial nettle inoculated from the same source, five leaves became infected. In both sets of experiments the control leaves remained healthy. Conversely, of 62 leaves of the hop inoculated with summer spores of the Downy Mildew of the nettle, eleven leaves became infected. In these experiments, however, three control leaves showed the disease, so that here the evidence becomes less trustworthy. Attempts will be made during the season of 1925 to place the question beyond doubt.

General Considerations.—The underlying causes of the recent appearance of this new disease of the hop must remain at present a matter of speculation. Two alternative theories may be advanced. The view may be held that the serious disease observed in the experimental hop garden at Wye College for the past five years and described above has been caused by a specialised and virulent form of the Downy Mildew

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* *Annals of Applied Biology*, Vol. XII, No. 2, 121-150 (1925) (*in the press*).

possibly imported into this country from abroad. This virulent form might be distinguished by its persistence on or in the hop plant during the winter, as the result of which the fungus appears year after year from the commencement of the growing season, and is thus able, given suitable weather conditions, to inflict the most serious injury on the crop. If the commercial varieties grown in this country are as susceptible to the fungus as those grown in the experimental hop garden at Wye have proved to be, it is quite certain that hop growers have had up to the present no experience of this disease, as it could not have occurred in their hop gardens without attracting attention. On the same theory the Downy Mildew which was observed in epidemic form during last autumn may be supposed to be another form of the same fungus (probably originating from the nettle and certainly native to this country) which possibly under certain weather conditions and late in the season can temporarily infect the hop plant, attacking the leaves and the cone, but not causing a permanent disease. On this view the hop plants would each year, and only under certain weather conditions, be infected afresh from diseased nettles. Such a temporary infection late in the season either in the hop garden or in the nursery would cause no appreciable harm and may well have occurred in this country in previous years without having attracted the attention of either the farmer or the scientist.

On the second theory, the fungus originally causing the disease at Wye and that found in the general epidemic of 1924 are assumed to be the same, to be native to this country on the nettle, and on this host within recent years, to have "sported" and developed a form capable of attacking the hop in such a way that it reappears year after year in the hop garden as a dangerous disease. If this view is correct, the events which have been noted since 1920 in the garden at Wye College seem likely to be repeated during the coming years in many a hop garden in Kent. The amount of injury then caused to the hop crop will depend on the susceptibility shown by the different varieties cultivated.

In the event of the disease being observed by any hop grower, it is desirable that the nearest technical advisory centre, or the Ministry, should be immediately informed.

Summary.

1. A description is given of a new and dangerous disease of the hop, caused by the Downy Mildew (*Pseudoperonospora Humuli* (Miyabe

and Takah.) Wilson), which was first noticed in this country in 1920, in the experimental hop garden at Wye College, Kent, and which has persisted from year to year, and caused considerable injury to the crop. In a previous article in this *Journal* (vol. XXX, 430 (1923)) the belief was expressed that the fungus causing this disease had been imported from abroad.

2. In 1924 a fungus indistinguishable from the above appeared in epidemic form during the autumn in hop gardens, hop nurseries, and on wild hops in the hedges, in several counties in England under circumstances which showed that the fungus was a native of this country.

3. Investigations have shown that the Downy Mildew which is common on nettles is almost identical with that on the hop, and that it is probable that the fungus can pass from the hop to the nettle and *vice versa*.

4. Two theories are advanced to explain the appearance in England within recent years of this new disease of the hop.

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AGRICULTURAL RESEARCH IN FRANCE.

A COMPARISON WITH GREAT BRITAIN.

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THE modern development of agricultural research in France is even more recent than in Great Britain, for whereas in the latter case it dates from the Development and Road Improvement Funds Act of 1909, the charter in the former case is the French Finance Act of 30th April, 1921. This law created at the Ministry of Agriculture an "Institute of Agricultural* Research" charged with the duty of "developing scientific research applied to agriculture with the view of increasing and intensifying agricultural production." There were a number of agricultural stations in existence previous to the establishment of the Institute, but they were badly staffed, research work was largely sacrificed to analytical work carried out to secure fees, the whole field of agricultural science was not covered, and the local stations were unevenly distributed over the country. The Institute has the task of thoroughly reorganising the agricultural research work, and of placing it on a satisfactory footing.

Status of Research Stations and Nature of Research Grants.—In France agricultural research is largely a strictly Govern-

* Agronomique has throughout been translated as "agricultural."

ment service. There are now some 88 stations and laboratories in that country, 58 of which are Government stations staffed by Government servants and controlled by the Institute of Agricultural Research. The chief centres are Paris, Versailles, Bordeaux, Clermont-Ferrand, Grignon, Montpellier and Rennes. In Great Britain, however, the policy has been adopted of entrusting agricultural research to research institutes either independently governed, or attached to Universities, grants in aid of expenditure of such institutes being made from Government funds (the Development Fund).

The French stations which are not Government stations belong mainly to local authorities. The practice as regards grants by the Institute to these stations is very much the same as in this country. The French Agricultural Research Institute gives grants (1) to university laboratories and other independent institutions, (2) to agricultural stations of the various departments, (3) to individual scientists working on agricultural problems. The first corresponds to British research institute practice, the second to grants to local authorities in this country for experimental work, and the third to special grants given in this country to individual investigators (through their institutes) for agricultural research into specific problems.

Governing Body.—The governing body of the French Agricultural Research Institute is the Administrative Council, on which the representatives of the Ministry of Agriculture have a majority—of the 28 members, 6 are nominated by the Academy of Science, 6 by the Academy of Agriculture and 16 by the Ministry of Agriculture. Of the nominees of the Ministry of Agriculture, 3 are Members of Parliament, 3 are agricultural or scientific notabilities, 3 are members of agricultural associations, and one represents the Ministry of Finance. The Director of the Agricultural Research Institute is an additional member of the Council; this appointment is made by the Ministry of Agriculture.

The Council's deliberations relate to financial and accounting matters; acceptance of gifts and legacies (the Institute is empowered to receive these); investment and borrowing of funds; the use of funds given to the Institute by local authorities; the formation or suppression of stations; the budgets and accounts of individual stations; and all questions concerning the personnel and work of the stations. The decisions of the Council can only be put into effect after approval of the Ministry of Agriculture.

So far as its deliberative functions are concerned this Council corresponds to some extent to the British Agricultural Research Council (composed, however, for the most part of directors of research institutes in England, Wales and Scotland), which meets for discussion of questions concerning research work. The administration of grants to institutes, and financial arrangements generally are in this country, however, retained by the Ministry of Agriculture and the Board of Agriculture for Scotland respectively. On technical questions the British Agricultural Research Council has another counterpart in France—the meeting of directors of stations. This question is further dealt with below under " co-ordination of research work."

Subject Division for Purposes of Research: Research Programmes.—The policy adopted in this country of dividing up the science of agriculture into subjects for the purpose of research, and of entrusting each subject to a different station, is being followed in France. The following is a comparison of the subject divisions:—

Great Britain.	*France.*
Soils (Plant Nutrition).	Soils.
Plant Pathology.	Entomology. Mycology.
Plant Physiology.	—
Plant Breeding and Crop Improvement.	Plant Breeding.
Horticulture.	—
Glasshouse Crops.	—
Animal Nutrition.	Animal Nutrition.
Dairying.	—
Animal Breeding.	Animal Breeding.
Animal Pathology (including Agricultural Parasitology).	Animal Pathology.
Agricultural Economics.	—
Agricultural Engineering.	Agricultural Engineering.
—	Agricultural Physics and Meteorology.
—	Agricultural Bacteriology.

The chief apparent omissions in the French programme compared with the British are plant physiology, horticulture, glasshouse crops, dairying and economics. Some of the British work on plant physiology corresponds to work allotted in France to the agricultural physics and meteorological stations. Doubtless too a good deal of the work carried out at our horticultural and glasshouse crops stations will in France be conducted at the stations for plant pathology and plant breeding; similarly dairying

work may also be carried out at the animal nutrition and breeding stations, and is dealt with to some extent at the bacteriological station (see later). Agricultural economics does not come within the French Agricultural Research Institute programme because it is entrusted by the Ministry of Agriculture to its Agricultural Intelligence Office; very little seems to have been done on this subject, however, and there is no provision for dealing with costing records by localities as in this country.

There are no separately recognised stations in this country for either agricultural physics and meteorology or agricultural bacteriology. The French research programme in agricultural physics and meteorology is thus defined: "Research into methods of using natural forces—whether thermal, actinic, electrical, magnetic, radio-active—in the development of plants. Research into methods of protecting crops against harmful meteorological phenomena, *e.g.*, frost, hail, etc. Research on the utilisation of meteorological observations in forecasting crop yields, and in predicting outbreaks of plant disease for the purpose of forewarning farmers."

In our own country work on soil physics is carried out at Rothamsted, and the Agricultural Engineering Institute at Oxford will also be concerned in the question. Agricultural meteorological work has been carried out hitherto in rather haphazard fashion, the principal station concerned being Rothamsted; observations have, however, been made elsewhere, *e.g.*, Cambridge, Cockle Park, Wisley, Newton Rigg, etc. Under a scheme now inaugurated by the Ministry (of which full particulars will be published elsewhere) this country is covered with crop weather stations at which both meteorological and crop observations (including phenological and plant pest observations) will be carried out, and attempts will be made by an *ad hoc* Standing Committee of the Ministry to correlate the two sets of observations. There is also a Committee of the Ministry for electro-culture research, carried out under the direction of the Plant Physiology Research Institute.

The following work is allocated to the French Agricultural Bacteriological Station: research for improving the fermentation industries, *e.g.*, wine making, cider making, brewing, distilling, vinegar making, cheese-making, butter-making, and flax retting. Work under these heads has not been brought together in this way in this country. Cider making is dealt with at the Long Ashton Research Station; brewing and distilling research is carried on by the Institute of Brewing, which, instead of receiving

a subsidy from Government funds, itself subsidises agricultural research on problems bearing on the brewing industry; research in cheese-making and butter-making is carried out at the National Institute for Research in Dairying; research into problems of flax and linen has hitherto been dealt with principally by the Linen Industry Research Association, which receives support from the Department of Scientific and Industrial Research and the Government of Northern Ireland.

The work to be dealt with in France under soils, plant breeding, animal breeding and animal pathology sufficiently resembles the programme of research institutes dealing with these subjects in this country to need no comment.

As regards agricultural entomology (zoology) it may be noted that, as in this country, bee-keeping is included, but the zoological programme in France is wide enough to include ornithological research directed to the protection of insectivorous birds and the destruction of harmful birds, and research into methods for the destruction of rats and mice and other small harmful animals. Of importance in France also is research in silkworm rearing. In this country rat destruction research is a matter in which the Ministry of Agriculture has directly concerned itself.

The mycological research programme in France is wider than the usual conception of such research in this country in that, in addition to dealing with fungus and bacterial diseases, it includes the destruction of weeds and parasitic plants and destruction caused by physical agents.

The French programme of nutrition research covers both animals and man, and includes research into poisoning, a subject which in this country is usually regarded as coming within the purview of animal pathology research institutes (so far as animals are concerned).

The agricultural engineering research programme in France is defined simply as the testing of motors and agricultural machines, apparently indicating a conception of the work less fundamental than in this country.

Co-ordination of Research Work.—Akin to the British Agricultural Research Council from the point of view of co-ordination are periodical meetings of the directors of French agricultural research stations and laboratories. Such meetings are held by the Council of the Institute to be desirable " because they lead to a closer and more efficient scientific collaboration between institutions whose programmes have many points in common, and aim at the same ends; it is often by an interchange of views

between technical men specialising in the same branch of knowledge that a method of analysis or a new process is brought to the test." Judging by the following list of the principal questions discussed at such a conference in 1923, it might have been held on British soil:—Agricultural soils and mapping; improvement of analytical methods; new manures and old methods of valuation; crop experiments; collaboration of chemist and geneticist; the importance of minute quantities of chemical compounds; analyses of feeding stuffs. A second meeting of station directors is to be held in Paris in April, 1925.

In order to ensure proper co-ordination the Administrative Council of the Institute has five technical committees: (1) Soils, (2) plants, (3) hygiene and feeding, (4) engineering, and (5) physics and meteorology.

The aim of the French Government is to have one central station for each of the ten groups of subjects into which agriculture has been sub-divided; it will be the duty of each of these central stations to co-ordinate the efforts of all the stations working on subjects within its group and to centralise the results. This does not, however, mean that the latter stations will be subordinate to the central station; they will retain their independence both administratively and technically, and will not necessarily become provincial dependents of the central station.

It is interesting to compare this aim with practice in this country. In subjects in which there are two or more research institutes, *e.g.*, soils, horticulture, plant breeding, animal nutrition, animal breeding and animal diseases, there is no question of any one station being regarded as subordinate to others; each preserves administrative and technical independence. Provision for co-ordination of work is made as already mentioned through the Agricultural Research Council, through frequent meetings of directors apart from the Council, and through special committees in the case of horticulture and animal diseases. A special arrangement obtains in this country as regards poultry: although feeding and breeding are dealt with at the different research institutes in these subjects, the work is co-ordinated and centralised in the National Poultry Institute. Somewhat closer co-ordination and centralisation has been adopted here, especially as regards crop improvement research and agricultural economic research. In the case of crop improvement, stations entirely subsidiary, technically, to the National Institute of Agricultural Botany have been established in various localities, and in the case of agricultural economics the work of advisory officers in

agricultural economics (who carry out economic investigations in the different provinces) is centralised at the Oxford University Institute for Research in Agricultural Economics. The organisation of provincial advisory officers in plant pathology is also used for co-ordinated work on any particular plant disease problem, and, so far as advisory officers generally are concerned, conferences are regularly held to ensure proper co-ordination of work. Further, a scheme has been inaugurated for research in pig husbandry in which research at several stations will be co-ordinated and centralised at the Animal Nutrition Research Institute at Cambridge. The practice of Research Institutes themselves establishing centres to test a particular problem seems to be growing in this country; it has been adopted notably by the Rothamsted Station and the Welsh Plant Breeding Station.

While dealing with the question of the co-ordination of experimental work, mention must be made of the action of the Ministry in preparing schemes of work on such subjects as agricultural meteorology, grassland improvement, and potato varieties. In general, co-ordination of experimental work carried out by agricultural colleges and county agricultural education authorities is regarded as a function of the Provincial Conferences—bodies principally composed of representatives of these colleges and authorities.

Practical Application and Publication of Results.—Arrangements have been made in France for linking the research station with farming practice. As soon as a result has been obtained by a research station which appears to have practical application, experiments under practical conditions are to be carried out jointly by the research station in question and the "Agricultural Offices" of the local authorities (departmental and regional) in France; the experiments are to be carried out for a sufficient length of time to test thoroughly the point under consideration. If the experiments confirm the research station results it is then the duty of the Agricultural Offices to popularise the methods or products by carrying out demonstrations. It is hoped in this way both to prevent premature recommendation of discoveries with consequent mistrust of scientific methods, and to secure publicity for results of proven value. The local stations, independently of this work for central research stations, carry out trials under practical conditions of methods, processes and products (including crop varieties) the use of which it appears might be of value locally. Such stations are also entrusted with

the work of multiplication of varieties and their sale; for the latter purpose associations of farmers willing to use improved varieties are formed.

In England and Wales there are various links between the results of fundamental research at the research institute and their application by the farmer in actual practice. The chief are the specialist advisory officers in various subjects (plant pathology, chemistry, economics, veterinary science) who carry out local investigations in which the fundamental results obtained at agricultural research institutes are applied to local conditions, and who also give advice; and the agricultural organisers and staffs of local agricultural education authorities, whose duty it is to keep abreast of current research for the purposes of their advisory work among farmers (which includes lectures, visits of advice, and demonstrations). Results of research also find a place in the agricultural press, and in this connection the *Journal*, leaflets and miscellaneous publications of the Ministry play an important part. Arrangements have been made recently for special series of lectures on research work to be delivered to audiences provided by the National Farmers' Union, and to be broadcast by the British Broadcasting Company.

An arrangement which does not obtain in Britain is made in France regarding the publication of research work. The Institute of Agricultural Research has two official organs for the purpose: the *Annales de la Science Agronomique*, and the *Annales des Epiphyties*. These are devoted to the results of all research work of interest carried out in the stations and laboratories of the Institute, and it is proposed that they shall also contain as complete a summary as possible of agricultural scientific work carried out in France and abroad. At present the accounts of such work are scattered among a host of publications of which the majority appear irregularly or have not sufficient agricultural interest to justify regular subscription. The Institute holds that it would be advantageous for many of these publications to disappear and for the work to be centralised as proposed. The present view in this country is that so long as the practical application of results of research work appears in the Ministry's *Journal*, leaflets, or miscellaneous publications, or in the agricultural press, agriculturists' needs are fully met, and that scientific workers are best left to publish an account of their work from the scientific point of view in the many scientific journals which

exist for the purpose. It must be remembered that the summarising of the results of research abroad is a very costly undertaking, and existing agencies are already at work on the task, viz., the International Agricultural Institute and the United States Department of Agriculture (which publishes the Experiment Station Record).

Finance of Research Work.—The funds at the disposal of the French Institute of Agricultural Research consist of sums previously available annually, and now transferred, for the payment of salaries of personnel, maintenance of Government research stations and laboratories, and for subsidising other research stations, etc., together with a new annual sum of two million francs provided for the purpose of filling up gaps in the research scheme by additions to stations, staffs, buildings and equipment. The budget of the Institute forms part of that of the Ministry of Agriculture, and amounted in 1923 to 4,472,000 francs; but to this must be added the receipts from certain taxes, subsidies from local authorities for the upkeep of stations and fees for analyses, bringing the total for 1923 to 5,561,000 francs. The expenditure in that year amounted to 4,079,000 francs so that there was a considerable sum unspent, unforeseen delays having occurred in the commencement of various building operations. The excess of income over expenditure is invested for the future benefit of the Institute. The total funds at the disposal of the Institute in 1924 exceed 6,000,000 francs.

This expenditure compares with a total expenditure from Government funds on agricultural research in England and Wales in 1923-24 of some £158,000 (this sum excludes expenditure on specialist advisory work and also grants in aid of experimental work by local agricultural authorities). Of this sum £140,000 was spent in grants in aid of capital and maintenance expenditure of Research Institutes.

The sums spent in France on upkeep of Government stations and in subsidies towards the upkeep of other stations amounted to 3,400,000 francs (of which salaries accounted for 2,455,000 francs). In addition sums were spent as follows in 1923 in completing equipment of stations: Machinery Testing Station (Paris), 80,000 francs; Veterinary Research Laboratory (Alfort), 92,400 francs; Phytopathological Station (Paris), 14,000 francs; Insectary (Mentone), 26,700 francs; Food Hygiene Station (Paris), 125,000 francs. The administrative council of the Institute has adopted the policy of concentrating agricultural research at certain centres. Thus at Versailles

buildings are being erected to house stations for the following :—plant pathology (zoology and mycology), plant breeding, soils, agricultural physics and meteorology; at Bordeaux for the following :—entomology, mycology, physics and meteorology, oenology; at Clermont-Ferrand for physics and meteorology, entomology and mycology.

The cost of the building at Versailles is estimated at 1,708,000 francs, and 17,000 francs has already been provided for working capital for the 42 acres of arable land attached to the centre. A building near Bordeaux has been acquired by means of a fund of 200,000 francs placed at the disposal of the Agricultural Research Institute by the Department of Gironde; and a building near Clermont-Ferrand has been acquired as the result of the provision of a sum of 200,000 francs by the Department of Puy-de-Dôme.

Subsidies to individual workers in 1923 amounted to 149,000 francs; this compares with special research grants in England and Wales in 1923-24 amounting to £3,094. In France, individual agricultural workers benefit in this way from other sources; an additional 254,000 francs was given in 1923 by various bodies. As the result of action by the French Academy of Science a general review of grants so made will be carried out each year in order to avoid duplication and over-lapping.

A statement made by the President of the Administrative Council of the Institute is worth quoting: "The funds at present placed at the disposal of the Institute are insufficient to permit it to carry out efficiently the work which it has undertaken; there will be a loss of precious time to agriculture, which hopes so much from scientific research and which impatiently awaits the solution of a large number of problems which it has placed before the Institute. It must be realised that the Institute will be able to obtain its own resources only very slowly. The problems on which it is engaged are of too general a character for their solution to serve the interest of any particular groups of agriculturists from whom support could be claimed. It is thus on the whole nation. *i.e.*, on State funds, that the Institute will have to rely for some time."

Staff.—The superior administrative staff of the Institute, who are civil servants, comprise a director, a "chef de bureau," a deputy chef de bureau, and an accountant.

The superior staff of the stations and laboratories comprised in 1923, 3 general inspectors, 3 directors of central stations, 52 directors of laboratories and 28 deputy directors. Of these,

8 directors, 6 deputy directors and 11 assistants were lent to subsidised stations: this is held to be a most effective way of aiding such stations.

The total salaries of the staffs of stations belonging to the Institute or lent to subsidised stations amounted in 1928 to 2,455,000 francs.

The recruitment of the technical staff presents great difficulties on account of the low commencing salary—6,000 francs. At the last examination for these posts two-thirds of the candidates were women, and the first three successful candidates were women. This is causing some anxiety as regards the supply of trained workers for the higher posts, since the majority of the women may be expected to marry and give up the service.

There seems to be no system in France for providing suitable recruits by means of Agricultural Research Scholarships in various subjects such as are offered in this country.

Very few women enter the research service in this country.

Research workers entering the French service probably compare with non-graded workers in this country, for whom there are no fixed rates, but who seldom rise above £300 per annum. The rates, however, fixed for graded research workers in England and Wales are:—Assistant. £300-£360 per annum; Senior Assistant, £400-£600 per annum; Principal Assistant, £600-£800 per annum—in each case with a small bonus varying with the cost of living, at present averaging about £45 per annum. The salary of Directors of Research Institutes in this country is in no instance less than £800.

The staffs of Research Institutes in this country are not in any way Civil Servants; they are employees of the governing body of the Institute.

Conclusion.—It will be seen that there are very many points of similarity in the organisation of agricultural research in Great Britain and in France. If, in France, there is a greater tendency to centralisation, this is not so great as we might expect having regard to the administrative history of the country. The looser organisation traditional in this country is gradually being tightened up, but not in such a way as to impair the freedom of the workers. Both as regards their personal emoluments and the provision of equipment, the research workers in France, even allowing for different standards of living and prices, seem to be at a disadvantage financially compared with research workers here, where as a nation we are not supposed to have a high regard for the claims of science.

CULTIVATION OF THE VEGETABLE MARROW.

Origin and Description.—The species and varieties of marrows, to which the gourd and pumpkin belong, are very numerous, and are all classed as tender or half-hardy annuals. They are monœcious, that is, the male and female flowers are distinct, but are borne on the same plant. All are natives of the warm parts of both hemispheres, and particularly India. Being hardier than their allies, the melon and cucumber, they succeed well as an outdoor crop in this country in ordinary seasons, providing an open sunny position is afforded, and high bleak situations are avoided. Although tender, the marrow is most accommodating in its requirements, and will grow in almost any kind of soil in which the roots can run freely and a sufficiency of moisture can be maintained, for the plant will not stand dryness.

Varieties.—Varieties of marrows cross so readily with each other that great difficulty is experienced in keeping any one variety distinct if other sorts are growing in the near neighbourhood and flowering at the same time. The abundant pollen grains are freely transmitted by wind and other agencies, as, for instance, the bumble bee, while not infrequently domesticated bees show a special taste for foraging on marrow flowers.

The varieties most favoured for garden or field culture are the Long White and Long Green, both smooth and ribbed, and they may be of either the bush or trailing types. There are various strains of these, some of which are quite distinct in shape, colour and texture of the fruit, as well as in freedom of cropping and earliness. Again, foliage and habit of growth are characteristic of some strains. The finely cut foliage of one, or the more rounded glaucous and marbled leaf surface of another is suggestive of their near relationship with the ornamental gourds and pumpkins of the Continent. These special types are generally to be found in the principle marrow-growing areas of Worcester, Bedford, Cambridge, Cheshire and the home counties, and are obtained from seed saved by growers from selected plants.

Propagation from Seed.—Well ripened seed is essential. Some growers who select and harvest their own seed prefer to use two-year-old seed, which, when kept carefully, becomes fully ripened and matured. As a means of encouraging quick germination, the seed may be placed in a canvas bag and soaked

for twelve hours in tepid water, or it can be spread out in thin layers in shallow boxes, moistened, covered with damp moss, fibre, or leaf mould, and placed in a warm greenhouse or store for thirty-six hours.

Two methods of raising plants from seed are usually practised :—

(1) Sowing the seed in pots under glass in early spring for transplanting to heated boxes and lights, frames, or heated pits for early cropping.

(2) Sowing the seed in the open where the plants are to produce their crop.

(1) For the first method three-inch pots filled with a compost of leaf mould, sand and loam in equal parts, or, failing this, any good garden soil, made light and porous by a mixture of sand or brick rubble, will suffice. Two seeds should be put in each pot in March, and covered with soil to the depth of 1½ in., placing the seeds as far apart as possible near the edge of the pot. As the seedlings appear they should be kept close to the glass to encourage sturdy growth, the stronger plant being eventually retained in each pot and the other pulled out. In the Evesham district three or four seeds are sown in a pot.

On the appearance of the first pair of rough leaves the plants should be planted out in their fruiting quarters in boxes and lights, frames, or pits, in which some form of heating can be controlled either by a fermenting material or by hot water pipes. To maintain a safe night temperature, covering in the form of mats, straw or bracken is necessary during cold spells of weather. The white bush form of marrow is most suitable for early cropping under glass.

(2) Marrows are usually sown in the open in May. The usual method is to excavate shallow holes 1½ to 2 ft. in diameter and 8 to 9 in. in depth, placing in the bottom two or three spadefuls of good well-rotted manure or other decaying vegetable refuse. Fresh manure should not be used. This is then covered with 8 to 9 in. of the excavated soil, or if the soil is poor or low in friability, by a top spit of good decayed turf. On filling in, a shallow mound will be left, on the top of which three seeds in the form of an equilateral triangle 8 to 10 in. apart should be buried 1½ in. deep. The resulting plants when in rough leaf should be singled so that one plant remains to each mound. Pot-raised plants for outdoor cropping may be planted out in a similar manner or singly on the flat.

Protection in some form is necessary for the seed beds and for the plants after they have been put out. Failing bell glasses

or hand lights, a ring of sheet tin or zinc, 12 in. in diameter and about 4 to 6 in. in depth, put over the seeds and covered with a sheet of glass weighted down with a stone, will suffice. Such protection is necessary for seed sown in April or early May, or for plants put out about this period. For later sowings or planting out at the end of May, inverted plant pots, bushel baskets, or oiled paper (thin wrapping paper dipped in linseed oil) form sufficient protection as a night covering until the danger of frost is past.

General Cultivation.—Marrows, whether they be grown in frames or in the open, respond to generous treatment, and will well repay the grower for the extra care and cost involved in providing for the crop as many favourable conditions as possible. Frame culture is of considerable importance because early marrows are much valued, and often realise high prices. Three conditions are essential to success in growing them under more or less artificial conditions :—

(1) A moderate bottom heat from fermenting material, and hot water pipes for top heat.

(2) A mellow loamy soil, in which the roots can run freely.

(3) Sufficient water, for the marrow is a thirsty plant, and the more vigorous the growth the more satisfactory the result.

In Frames.—The temperature for early marrows in frames may range from 55° F. to 80° F., the safe medium being about 65° F. when the weather is cold and dull, up to 80° F. when strong sunshine prevails and the plants are growing freely with plenty of air. The crop must be ventilated freely on all favourable occasions.

Regular supplies of water (at the same temperature as the pits) must be supplied so that the bed is always reasonably moist, care being taken not to direct the water on to the main stems of the plants. A light spray of water over the foliage before closing down in the evening is also beneficial. Care should be exercised in the regular use of water, for failure will result in a deficiency of fruit. A little soot occasionally sprinkled around the young plants and over the soil surface will help to ward off slugs and will stimulate the crop. If the plants show signs of weakness liquid manure should be applied to the soil around them. Sulphate of ammonia and superphosphate can be applied at the rate of 1 oz. to the square yard and watered in.

If trailing varieties are grown the training out of the plants is a simple matter. They should run their own way until they have made shoots eighteen inches long, then the points should be nipped out, after which there should be no more stopping, but

occasionally the laterals must be suppressed to prevent crowding. The point at which the plant should be stopped is determined to some extent by its vigour, and some growers do not stop shoots until they are 3 to 4 ft. long. Bush marrows should not be stopped.

To ensure an early set of fruit, hand fertilisation should be resorted to as soon as the fruit flowers (female) appear. It will generally be found that the male flowers are the first to appear, generally in clusters near the base of the main stem or shoots.

In the Open.—If seed is sown outside generous treatment is equally important. Where land and labour are costly, and the summer season not too certain, it pays to provide every possible favourable condition for the crop.

If one can choose, a black soil is to be preferred, as such soils are warmer and more favourable to the early growth of the plant than a heavy loam or clay soil, though both of these can and do produce good crops of marrows when deeply worked and liberally treated with organic matter.

The marrow crop usually follows a crop of late brassicas, such as sprouts, savoys, or cauliflowers. These crops coming off the ground early in the year allow the grower time to work the land well and obtain a good tilth. Marrows benefit by shelter during their initial stages of growth, and can be grown with advantage on " lands " divided by " breaks " of broad beans.

The average distance allowed between the rows of bush marrows is 4 ft., and between the plants 3 ft., whilst the trailing varieties may be 4 ft. between the plants, and at least 8 to 10 ft. from row to row. With the latter, intercropping with catch crops of lettuce, radish, spinach or early turnips can be carried out, allowing two feet between the intercropping rows for horse hoeing and surface cleaning.

Providing the soil has been deeply worked, and contains plenty of humus, and a surface tilth is kept up, it should be sufficiently retentive of moisture to carry the plants on until they have formed a good root system, and have sufficient foliage to shade the ground. If, however, there should be a partial or absolute drought during the early growth of the plants it may be necessary to water them, but this should be done with great caution. It would be better and certainly safer to apply a light mulch of short litter or half decayed vegetable refuse, and if water must be used as a last resort, to leave it first exposed for some hours to the air in open tanks or barrels. Mulching

also serves to protect the marrows from being splashed with mud during heavy rain.

When the plants commence to fruit an occasional dressing of sulphate of ammonia and superphosphate can be given at the same rate as for the frame crop, or fish guano, at the rate of 1 oz. per square yard, may be hoed in between the rows of plants.

Cutting the Crop.—The marrows should be cut when quite young, the earliest fruits being about 8 inches long when marketed, and in no case should they be allowed to remain on the plant beyond medium size. The production of the young fruits does not to any appreciable degree exhaust the plants for successional cropping. When, however, the fruits are allowed to develop, and the fruit stalk to become hard, the production of fresh fruits is quickly brought to an end.

Marketing.—The earliest marrows are usually wrapped in rhubarb or cabbage leaves, and packed between layers of paper in half-bushel hampers or half pots holding about one and a half dozen. Later, when prices fall, about a dozen marrows are put up in a bushel hamper or pot and covered with pea haulm or straw, or about three or four dozen are marketed in a cabbage crate. They are also carried loose in market vans or lorries direct to markets or retail shops, but this is a practice not to be recommended as it leads to much damage from the constant handling necessitated.

PESTS AND DISEASES OF THE VEGETABLE MARROW.

Root Knot Disease.—The pest causing this disease is among the worst that the cucumber, melon and tomato grower has to contend against. Marrows grown under glass are no less susceptible. The disease is caused by an eelworm (*Heterodera radicicola*), which burrows into the roots and causes minute warts or nodules on the rootlets, ranging from the size of a pin's head to that of a pea. Under the influence of the eelworms the root system eventually breaks down with the consequent destruction of the plants. A female eelworm is capable of laying 500 eggs, and as there are many generations in a year, the multiplication of the pest is rapid. The young worms are able to move through the soil, but only very slowly, and the spread of the pest from one bed to another is caused entirely by the transfer of contaminated material.

Control.—Chemicals applied to affected soil have no lasting effect, and where practicable the best measure to employ is to move all the soil to a good depth from the pits, treat the

brickwork with hot lime-wash, and bring in fresh soil. Where suitable plant exists the soil may be satisfactorily sterilised by hot steam under high pressure, or—where the soil to be treated is not large in quantity and is spread thinly—considerable effect may be obtained by the use of boiling water at the rate of 7 gallons to the cubic foot.*

Slugs and Woodlice.—These pests, especially woodlice, frequently give trouble when manure from old spent hotbeds is used. Both are destructive to young plants and small fruits. Dusting round the plants with soot has the effect of deterring the pests from feeding on the plants. Dry Bordeaux mixture might also be used. it would prove more deterrent and the effect would last longer. The pests themselves may be trapped by means of pieces of potato, carrot or beet, placed under boards or slates. The traps should be examined at fairly frequent intervals and the animals destroyed.†

Wireworms.—Wireworms are often troublesome when marrows are grown in grassland which has been recently broken up. These insects may be very successfully trapped by means of potatoes buried just under the surface of the soil, each potato may have a stick pushed through it in order to mark its position, and to serve as a handle for lifting it when it is desired to examine it.

Red Spider and Thrips.—These pests not infrequently make their appearance if the atmosphere and the soil are allowed to become too dry. Consequently the best preventive, and even remedy if the attack is not too bad, is the judicious application of water to the soil, foliage, etc. Care should be taken that the water is at the same temperature as the house containing the plants.‡

Powdery Mildew.—Fungus diseases of marrows grown in the open are fortunately comparatively rare. The commonest is that caused by a powdery mildew (*Erysiphe cichoracearum*, D.C.), which not infrequently appears towards the end of the season when the fruiting period is almost completed. In certain seasons, however, it appears during the earlier part of the summer, especially when a period of damp weather follows one of dry heat, and it sometimes occurs on quite young plants.

* For information on the chemical treatment of soil see Robson, *Jour. Roy Hort. Soc.*, May, 1919, Vol. 44, p. 31

† For treatment in greater detail see "Woodlice in Glasshouses," by E. R. Speyer, this *Journal*, Feb., 1924, p. 1042.

‡ For chemical treatment of a severe infestation see Speyer, *Nature*, 7th June and 9th Aug., 1924.

The leaves and younger portions of the stem become more or less covered with a white powdery growth which, under the conditions mentioned, spreads rapidly and may do considerable harm to the plant, or even kill it outright.

If the mildew does not appear until August it is perhaps scarcely worth while attempting to control its spread, but the diseased plants should be destroyed by burning. When it occurs during the earlier summer months, however, it should be dealt with immediately. Badly infected plants should be uprooted and burned, whilst those less seriously affected should be sprayed thoroughly with a solution of potassium sulphide (liver of sulphur), 1 oz. to 3 gallons of soft water. Dusting the plants with flowers of sulphur when they are damp is also an effective method of checking the disease.

Some of the diseases of melons and cucumbers under glass are also capable of attacking marrows when the latter are grown in frames or pits. Amongst them the two following may be mentioned :—

Leaf Spot (*Cercospora melonis*, Cke.).—This disease first appears as small pale green spots on the upper surfaces of the leaves. Later the spots increase in size and, finally, irregular patches of a grey or brownish colour are produced, the leaves frequently withering very rapidly.

All diseased leaves should be gathered at once and burned. In severe cases it is advisable to spray with a solution of liver of sulphur (1 oz. in 3 gallons of soft water) to which 1½ oz. of previously prepared and boiled flour paste have been added to facilitate wetting and adhesion. A buoyant atmosphere should be maintained round the plants by judicious ventilation. Watering should be done with discretion, and heavy dressings of stimulating fertilisers should be avoided.

Anthracnose (*Colletotrichum oligochætum*, Cav.).*—In its early stages this disease also takes the form of small pale green spots on the foliage. These quickly enlarge and become round and dry. The centres of such spots usually assume a reddish colour, while the margins are more or less yellow and appear water-soaked. On them the parasitic fungus produces minute pustules in which myriads of spores are borne. Ultimately the leaves wither as the spots enlarge and unite. If not checked in the early stages the disease spreads to the leaf-stalks and young stems, causing considerable damage. The measures of

* See "Anthracnose of the Cucumber under Glass," by W. F. Bewley, this *Journal*, Aug., 1922, p. 469, and Sept., 1922, p. 558.

control recommended for Leaf Spot may also be used for Anthracnose. Uneven temperature and excessive dampness of the air should be guarded against, since these factors are highly favourable to the development and spread of the disease. Soil acidity should be corrected by the judicious application of lime.

Collar-rot.—Marrow stems sometimes rot off at their bases near soil level, or immediately behind the fruit. This is not a *specific fungus disease and is usually attributed to careless watering with too cold* water. If a number of drops of water remain near together on the stem, rotting usually sets in at such places. In watering marrows, it is desirable to avoid wetting the stems by applying the water at least six inches from their bases. Powdered charcoal and quicklime mixed in equal proportions and placed around the injured parts will prove of value.

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COUNCIL OF AGRICULTURE FOR FOR ENGLAND.

THE fifteenth meeting of the Council was held at the Middlesex Guildhall, Westminster, on Thursday, 19th March, 1925. Mr. James Donaldson (Oxon.) was unanimously elected as Chairman for the year 1925. A cordial vote of thanks was passed to the retiring Chairman, Mr. George Edwards, for his services during 1924.

Statement by the Minister of Agriculture..—The Minister of Agriculture (the Right Hon. Edward Wood, M.P.), made a statement dealing generally with the agricultural situation. He said that at the December meeting he had referred to the prospect as a more hopeful one, and this was still the case so far as figures showed. The index number of the prices of agricultural commodities was on the whole rising, and was now three or four points higher than November.

He then referred to the abortive Agricultural Conference and informed the Council that he had, in addition to asking the organisations originally invited to the Conference, invited the Royal Agricultural Society, the Central Chamber of Agriculture, the Surveyors' Institution and the Land Agents' Society—and he now invited the Council of Agriculture—to make proposals to him so that the Government might be in possession of the views of all, and thus be in a position to develop an agricultural policy which was likely to be continued in the future and secure the industry from the danger of sudden or sharp reversals of national policy.

With regard to the Beet Sugar (Subsidy) Bill, this measure would, he hoped, be in a position to receive the Royal Assent in time to be operative by the end of the month. The Government had done its part and he thought it was up to the factories and to farmers to do theirs. In saying that, he meant that it was up to the farmers to grow adequate supplies of beet to meet the factories' requirements. The factories had agreed on terms which, from the farmer's point of view, could not be regarded as anything but satisfactory. The further outlook was one for the farmer and the factory so to develop the industry that at the end of the ten-year period it could stand well upon its own feet without a subsidy.

The Agricultural Rates Bill, which had now been passed, continued the privileges of last year's Act to agriculture, and this meant a relief of nearly three millions a year to farmers' rates. He congratulated the new Agricultural Wages Committees on the progress which they had made.

The Minister also informed the Council of the terms of reference of a Departmental Committee which he proposed to set up, jointly with the Secretary for Scotland, on the subject of Unemployment Insurance for Agricultural Workers. The Council of Agriculture had proposed the appointment of this Departmental Committee and he would refer its report to the Council for their views upon it as soon as it was issued and before any other action was taken.

The Minister added, with regard to the Report approved at the last meeting of the Council on the subject of the conditions of seasonal employment on the land, urging the Ministry to take action for the improvement of the conditions of employment of women and children, that he had conferred with the Minister of Health, and it had been decided first of all to approach the question of conditions in the Kent hopfields. A revision of model by-laws dealing with sanitary conditions was being considered by the Ministry of Health, and he hoped to issue a circular to hop growers urging co-operation with local authorities for the purpose of securing a reasonable standard of decency and comfort for those engaged in the seasonal work of hop-picking. The Ministry's inspectors would collect further material as to actual facts and conditions in relation to seasonal employment with a view to further educating public opinion upon the subject.

The Rt. Hon. F. D. Acland moved a vote of thanks to the Minister for his statement and asked, in regard to the proposed Committee on Unemployment Insurance, whether it would be

asked to explore the question and set out a scheme, even though a majority of the Committee was not in favour of bringing agricultural labourers within the scope of unemployment insurance.

Mr. George Dallas seconded the vote of thanks and congratulated the Minister on his full statement, which he said reflected the confidence of the Minister and the industry in the Council.

Mr. R. A. Matthews (Hereford), *Colonel G. L. Courthope, M.P.* (East Sussex) and *Lady Mabel Smith* desired to associate themselves with the vote of thanks. *Colonel Courthope* remarked upon the fact that with regard to the conditions of seasonal employment in the hop-fields the people themselves were often the greatest obstacles to improvement in their conditions. *Lady Mabel Smith* hoped that what was being done for the Kent hop-fields would soon be extended to the fruit-picking fields, especially the new ones, as it was always easier to start with better conditions in new schemes than to improve old ones. She inquired also as to the position of seasonal workers under the National Health Insurance. *The Minister* promised that he would consider Mr. Acland's point in regard to the Unemployment Insurance Committee.

Supplies of Lime.—*Sir Daniel Hall* referred to the suggestion made at the last meeting of the Council that a report should be furnished by the Ministry as to the adequacy and suitability of the existing sources of supply of lime for agricultural purposes. Certain inquiries had been made and it did not appear that the difficulty in regard to lime was in the supply. The price and cost of transport were, however, real difficulties. In order to get over them, there was the Ministry's scheme by which farmers who formed themselves into agricultural credit societies could obtain loans for the purchase of lime. A leaflet had been issued on the scheme and widely distributed throughout the country. So far, although many inquiries had been made, no society had yet registered itself or applied for a loan. He hoped, however, that the scheme would bear fruit in the coming year. *Colonel Wheeler* (Salop) said that it would help the supply of lime if the small lime-kilns about the country could be reopened. *Sir Merrik Burrell* added, however, that there was a lack of skilled lime-burners.

Rural Housing.—*The Rt. Hon. F. D. Acland* moved on behalf of the Standing Committee that its report on the question of the shortage of houses in rural districts be adoped. The report recommended that the Council should urge upon the Ministry of Agriculture the necessity of securing immediate action by the

Government to provide a large number of houses suitable for agricultural workers in rural districts as a national social question of first-class urgency and importance. He thought that rural housing tended to fall between the Chamberlain Act and the Wheatley Act. He hoped that the Government would carefully consider the principles of a Bill to be presented by Sir Alfred Knox and others. *Mr. J. T. Briggs* (Peterborough) referred to the Government's wish for a further million acres, if possible, to be brought under arable cultivation. and said that the lack of houses made it out of the question to get the necessary labour to do anything of that sort. There was a lack of sympathy and help from the Ministry of Health and the local authorities. Ever since December he had been trying to get some small assistance to build three houses on a farm of 300 acres, which had but one cottage. and he was no nearer success to-day than at the beginning. *Colonel Courthope, M.P.*, said that there was a definition of an "agricultural parish," under the existing regulations. which ruled out practically every parish which contained a villa or any residence beyond the doctor's and the squire's houses. He was told that there were hardly any rural parishes for the purposes of the Wheatley Act in the Home Counties. He would ask the Minister of Agriculture to urge the Minister of Health to exercise his discretion to prevent the ruling out, in this way, of parishes which were really agricultural. There were many rural cottages with three bedrooms, the present occupants of which—old couples or widows—only wanted two, so that it might help if two-bedroomed cottages were built for their accommodation and the larger cottages made available for the larger families. *Brig.-General Clifton Brown, M.P.* (West Sussex), said that there were thousands of cottages which ought to be occupied by agricultural labourers which were being occupied by the employees of county councils, railway companies, etc. He hoped the Ministry would ask the Minister of Health to circularise those bodies suggesting that they should find new cottages for their employees. *Mr. C. P. Hall* (Bedford) agreed with General Clifton Brown that it was the first duty of those public authorities which were pushing forward housing schemes to house their own employees. *Mr. John Beard* said that no scheme was likely to be a success if crowded with conditions, and if it attempted to fit houses to men who could not afford to rent them. A subsidy was necessary, and houses built for landworkers must be retained for them. At present, townsmen were buying cottages, or renting them furnished, as week-

end residences. Any man settled in a parish ought to be given a piece of land if he undertook to build a house upon it. With the increase in the value of land, the rent of houses would soon be put beyond the reach of agricultural workers unless safeguards were employed. If disused brickyards, old lime-kilns, and small stone quarries could be brought into commission again, housing in rural districts might be aided and a subsidy for these purposes would be worth while. Frequently, there was good brick clay in rural districts, but instead of making bricks there, they were brought at great expense from Peterborough. *Mr. Geo. Dallas* said that the question ought not to be a Party question, or even a controversial one amongst agriculturists. There was no question but that young agricultural workers were being driven away from the villages altogether. They got married and settled down in the only place where they could get a home, namely, in the town. *Mr. T. W. Atkinson* (Kesteven) said that his rural district council had recently built 72 houses and let them to agricultural workers. Rural district councils required to be reminded of their duty.

The Minister of Agriculture said that he had given this question very careful consideration for years past, but did not take so gloomy a view of it as Mr. Beard did. He had been in consultation with the Ministry of Health recently on the question and was assured that that Minister was very fully alive to its importance. *Sir Walter Berry* said that his experience was that townspeople were prepared to give double or treble as much as the agricultural labourer could pay in rent for rural cottages. *Mr. R. G. Patterson* (Staffs) said that in two villages near his farm nearly all the cottages were occupied by farm workers when he went there first. Now, the only cottages so occupied were tied cottages. Were it not for these, he could not continue his farm. There was a great demand for houses in the country from town workers, and, if no restrictions were put on the occupancy of cottages, no matter how many they built the question of rural housing for agricultural labourers would not be solved. *Mr. Haman Porter* said the land did not pay and it seemed of little use to encourage workers to settle on the land. *Mr. H. C. Gardner* (Worcester) said that the County Council had only this week passed a resolution to inquire into the manner in which his district council was doing its duty in regard to the supply of cottages. *Major Fawkes* (West Riding) said he did not think townsmen should be kept from living in the country. He would like the report referred back to the Standing Committee for

further consideration, and for a recommendation of definite action to be taken to the Council at its next meeting. *Mr. R. C. Grey* (Hunts) said that the rural district councils in his county were heartily sick of the whole question. The houses put up cost them about £900 and certain expenditure on them was being disallowed and rural district councils surcharged with it. The County Council had built 50 or 60 houses for their own employees. About a third of them only were being occupied by them. There was no housing question in his district, and, were it not for the fact that people came from urban districts to rent cottages, a number would be empty. *Mr. Acland* said that the Standing Committee would, if it were the Council's wish, certainly explore the matter further, though he thought that that should be done altogether apart from asking the Council to adopt the present Report. *Major Fawkes'* suggested amendment was then withdrawn and the Report adopted.

Small Holdings Legislation.—*The Chairman of the Standing Committee* (Mr. Acland) moved the adoption of a report which recommended that the Council should urge upon the Government—

1. To take steps to obtain a full and complete settlement of the financial position in regard to statutory small holdings by the date appointed—1st April, 1926.
2. To make a comprehensive small holdings scheme one of the main measures of their legislation programme of 1926.
3. To publish the principles on which such a scheme would be based this year, so that it may be properly considered by all concerned, with a view to facilitating its early passing into law, and its successful administration when passed.

Sir Douglas Newton, M.P. (Cambs.), said that the question of the settlement was receiving the closest attention of the County Councils Association, and he thought that a satisfactory settlement would be made. The Report made no mention of allotments, and he suggested that the Minister might be asked to take steps to encourage and promote the development of allotments so as to provide security of tenure so far as practicable and compensation for disturbance. *Colonel Abel Smith* (Herts) said that with regard to (1) of the recommendations it was not, in his opinion, in the interests of the small holdings movement that the settlement should now be pressed in view of the very unstable state of agriculture. No one could say what the economic position of small holders would be in the future. He moved, therefore, that recommendation (1) be referred back to the Standing Committee for further consideration. *Mr. Geo. Edwards* seconded this amendment. *Alderman Quinney* (Birm-

ingham) spoke in favour of allotments legislation. *The Chairman* pointed out that the Report before the meeting dealt only with small holdings. *Mr. Acland* added that the Standing Committee would look into the question of allotments legislation as a separate subject, and bring it before the Council at the next meeting. Recommendation (1) was fundamental to the position which the Standing Committee had taken up. *Mr. H. W. Thomas* (Hants), *Mr. J. S. Gibbons* (Gloucester) and *Mr. R. G. Patterson* spoke against the postponement of the settlement. The amendment was put to the meeting and lost, and the original motion to adopt the Report carried.

Election to Standing Committee.—*Mr. R. G. Patterson* moved and *Mr. McCraken* seconded the election of *Mr. Clement Smith* (East Suffolk) to the Standing Committee of the Council in place of the Chairman, who became a member of the body *ex-officio*.

CONTACT BETWEEN THE COUNCIL AND THE AGRICULTURAL COMMITTEE. —*Mr. Acland* moved the adoption of the Report made by the Standing Committee on this question. It recommended that representatives appointed by Agricultural Committees should keep their Committees in touch with the work of the Council, both by furnishing reports and agenda showing intended action, where possible, and by personal reports on action taken by Council meetings. Wherever such representatives desired that copies of agenda, reports and minutes should be sent to the Secretary of their Agricultural Committee, the Secretary of the Council would send them on request by such representatives. *Mr. A. Matthews* (Hereford) spoke in favour of the recommendation, and *Mr. A. Bath* said that Agricultural Committees ought to be in possession of the details of the Council's proceedings before questions were discussed. A report of each meeting ought, he thought, also to be sent to each Agricultural Committee and placed upon the agenda for discussion. *Mr. R. W. Hall* (Hereford) said he had been much impressed by the way in which the Council transacted its business, and he thought that reports from it should be brought before Agricultural Committees. He supported the recommendation. The Report was adopted.

REPORTS OF AGRICULTURAL ADVISORY COMMITTEE.—*Mr. Acland* moved the adoption of a Report from the Standing Committee recommending that "as the reports of the Agricultural Advisory Committee are furnished for the information of the Council and as it is desirable that notices of motion by members of the Council should be reached before the more formal business on the agenda, no change should be made in the order on the agenda as at present followed." The motion was seconded, and the Report adopted.

RATING OF SMALL HOLDINGS.—*Mr. Denton Woodhead* moved:—

"That the Council urges upon the Ministry of Agriculture and County Small Holdings Committees the desirability of render-

ing every assistance in their power to any small holders whose assessment for rating purposes is on a higher level than that of occupiers of neighbouring land, with a view to objections being lodged on the ground of unfairness."

Capt. E. T. Morris (Herts) seconded the motion and said he thought it would be very useful if the Ministry gave instructions to its Inspectors to go into the question in order that appeals might be made and substantial reductions secured in the burden of rating which small holders were bearing. *Mr. R. W. Hall* supported the resolution. In Herefordshire the Chief Agricultural Officer was instructed to appear before the Assessment Committee and do all that was possible to obtain relief. *Mr. A. Bath* said that in Middlesex, the County Land Agent had taken up the question of rating for small holders. *Mr. H. E. S. Upcher* (Norfolk) and *Mr. R. G. Patterson* also spoke in favour of the resolution, which was put to the meeting and unanimously adopted.

DOUBLE-DIPPING FOR SHEEP SCAB.—*Mr. R. W. Hall* moved:—

"That the necessity for a unanimous double-dipping Order for the eradication of sheep scab be urged upon the Ministry of Agriculture."

He said that there appeared to be no doubt that double-dipping of sheep was essential to the eradication of sheep scab. *Col. Wheeler* seconded the motion, which was supported by *Mr. A. Matthews* and *Mr. H. Dent-Brocklehurst* (Gloucester), who said that his county had joined with nine or ten other counties in making an Order that no sheep should come into the clean area unless they had been double-dipped twice in 14 days, once just before coming into the area and once four days after arrival. *Mr. Clement Smith* (East Suffolk) said that he was sure his county would strongly oppose a compulsory double-dipping Order for clean counties. He moved an amendment:—

"That a double-dipping Order for the eradication of sheep scab be urged upon the Ministry of Agriculture for those counties where the disease exists."

The amendment was seconded by *Mr. Owen Webb* (Cambridge) and supported by *Mr. W. H. Thomas.*

Lord Bledisloe, Parliamentary Secretary to the Ministry of Agriculture, said that the whole question was at present under the serious consideration of the Ministry and that it would be easier in another month or so to say what the future policy in regard to sheep scab was likely to be. At present, the practice was that double-dipping within 14 days was insisted upon in the bad areas. *The Chairman* then suggested that in view of this statement it would probably be better to stand the matter over for the present. He therefore suggested that the mover and seconder might agree to withdraw the motion until the next meeting, when in all probability some definite step could be announced. This was agreed and the motion withdrawn.

SURPLUSES IN NATIONAL HEALTH INSURANCE.—*Mr. Denton Woodhead* moved:—

"That the Council should make representations to the Royal Commission on National Health Insurance showing the great injustice that would be inflicted on the agricultural industry, both employers and employed, if a system of pooling the surpluses of Approved Societies administering National Health Insurance were adopted."

Capt. E. T. Morris seconded the motion, which was supported by *Alderman Thomas Davies* (Durham) and *Mr. Christopher Turnor*, and carried unanimously.

GUARANTEES FOR WHEAT.—*Mr. H. W. Thomas* moved:—

> "That in the national interest the cultivation of wheat should be encouraged by the Government guaranteeing the cost of production to the producer"

Mr. Thomas said that he had withdrawn a similar resolution at the last meeting of the Council in view of the expected meeting of the Agricultural Conference which, however, had not taken place. Only 20 per cent. of the flour used in this country was made from home-grown wheat, and the percentage might, he thought, well be increased to 40. The Agricultural Wages Act had substantially increased the cost of corn production. He wished, however, to speak from the standpoint of the national interest. He considered guarantees justifiable as a form of national insurance. *The Chairman* drew the Council's attention to the fact that it had been invited that morning by the Minister to contribute to the body of suggestions towards a suitable agricultural policy He did not know how far the carrying of the present motion might take the Council, and how far it might prejudice its freedom in making suggestions. He would therefore ask Mr. Thomas to withdraw his motion and leave the suggestion with the Standing Committee. *Mr. Thomas* agreed to this course on the understanding that the Standing Committee would take up the question.

REPORT OF AGRICULTURAL ADVISORY COMMITTEE.—*Mr. Dallas* moved that the Report (No. 9) of the proceedings of the Agricultural Advisory Committee for England and Wales be received. The motion was duly seconded. *Mr. C. P. Hall* supported it, but regretted that the Report contained no reference to land drainage. He wished to move an amendment in these terms:—

> "That this Council requests the Agricultural Advisory Committee to consider the question of land drainage as being of the first and most urgent importance in connection with any proposal making for increased production."

Mr. Dallas suggested that the amendment was really a recommendation to the Advisory Committee, and need not be moved as an amendment. *Mr. Hall* agreed, and *Lord Bledisloe* said that the Ministry welcomed items appearing on the agenda of the Agricultural Advisory Committee that are not put there by the Ministry. The Ministry realised the immense importance and urgency of land drainage, and had, in fact, a Bill under consideration which the County Councils Association were considering, with the object of giving county councils much larger powers than in the past over drainage areas within their administrative districts. The original motion to receive the Report was then put to the meeting and carried.

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AGRICULTURAL ADVISORY COMMITTEE FOR ENGLAND AND WALES.

REPORT (No. 9) to the Councils of Agriculture for England and Wales on the Proceedings of the Agricultural Advisory Committee:—This report contains a note of the proceedings of three meetings, namely, those on 1st October, and 10th December, 1924, and 4th February, 1925. The first of these three meetings was held whilst Mr. Noel Buxton was Minister.

(1) **Foot-and-Mouth Disease.**—At the first of the meetings, the Ministry's Chief Veterinary Officer reported that the position had become much more favourable There were in England six areas only then under control, namely, in Nottingham, Lincoln, Northampton, Oxford, Wiltshire and Essex. In Scotland, there had been no outbreaks for 3 months, and representations were being made for the reduction of the 28 day period for detention of Irish store cattle on farms in Scotland to 6 days' detention, which was the period prescribed before the present recrudescence of disease. The Committee was asked to advise whether a return should not now be made to the requirement of the 6 day period so far as Scotland was concerned. The Committee agreed that it should be so, subject to a provision that if there were any deliberate attempt on the part of dealers to bring Irish cattle through Scotland with this short period into England, the Ministry ought immediately to reconsider the whole position. The question of Local Authorities' regulations restricting the movement of animals into their areas was once more considered, but it was decided to postpone it pending the report of Mr. Pretyman's Committee on Foot-and-Mouth Disease. The Committee also considered the question of penalties in prosecutions for the illegal movement of animals in contravention of Foot-and-Mouth Disease Orders. The Committee agreed that whilst the fine per head might prove a sufficient deterrent to contraventions where a number of animals was involved, it might not do so where only one or two, or a few, animals were involved. To remedy, this, and as the offence was the same whether one or a number of animals was moved, it recommended that the Ministry should examine the position and see whether it was not possible to prescribe a large maximum fine for the offence

irrespective of the number of animals whilst retaining the power to inflict a heavy penalty on the illegal movement of a large consignment.

(2) **Agricultural Co-operation and Credit.**—It was reported to the Committee that the Agricultural Organisation Society had been dissolved and that the National Farmers' Union had agreed to take over a substantial part of the work hitherto done by them. This the Ministry regarded as a hopeful sign that increased progress in the movement would be attained. The Advisory Committee on Credit and Co-operation had dealt with a number of applications for loans out of the funds which had been made available by the Government for co-operative enterprise started by farmers. These applications were from 9 societies for loans of £50,000. In 5 of the cases loans had been recommended to the total of about £12,000; in the other cases the Committee had not been able to recommend the loans asked for. The Ministry was pressing forward the work of investigation into marketing problems with a view to better advice than hitherto being available.

(3) **Liming of Land.**—It was reported that facilities under the Agricultural Credits Act, 1923, to assist farmers to obtain loans for the liming of land were available provided societies were formed, or existing societies used for the purpose. The Ministry was anxious to assist liming wherever it was required.

(4) **Proposed Conference on Agricultural Policy.**—At the meeting on 10th December, the Minister informed the Committee of the action which the Government had taken in regard to the proposed Conference. At the meeting on 4th February the Minister informed the Committee that the Workers' Union had now intimated that in their view no useful purpose would be served by their appointing representatives to the Conference as requested. As was generally known, the National Union of Agricultural Workers had decided some time earlier not to appoint representatives.

(5) **Re-introduction of Tuberculosis Order.**—The Minister consulted the Committee in regard to the proposal to re-introduce the Tuberculosis Order with the Milk and Dairies Act next September. The Committee agreed in general principle to the proposal, though the question was reserved for further consideration in detail when plans should be more mature.

(6) **Suggested Register of Movement of Live Stock.**—The Committee considered the following request which the Ministry had received from the National Farmers' Union: "In order to facilitate the operation of the Ministry's policy in foot-and-mouth disease to ask the Minister of Agriculture to issue an Order requiring all owners of live stock to maintain a register showing all movements of stock under their control." It was agreed that the matter should be looked into, and the Ministry undertook to prepare a draft Order for preliminary consideration with the recommendation which it was understood the Pretyman Committee were making on the point.

(7) **Sheep Scab Policy.**—The Committee considered a memorandum dealing with the preliminary step in revising the general Sheep Scab policy of the Ministry. It dealt with the withdrawal of "single dipping" regulations. The Committee concurred in the proposal that all single dipping regulations should be withdrawn.

(8) **Reports of other Departmental and Advisory Committees.**—Two reports of the proceedings of other Committees have been received by the Committee. *(20th February, 1925.)*

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APRIL ON THE FARM.

J. R. Bond, M.Sc., M.B.E., N.D.A. (Hons.),
Agricultural Organiser for Derbyshire.

Seasonal Operations.—April is one of the busiest months of the farm year. This season the first duty will probably be to complete the sowing of spring corn, for until the middle of March little land other than light soils came into drillable condition, and considerable areas had been unfit to plough. Late-sown oats are always the most badly "fritted," but the frit fly does more damage in some years than in others. It was very bad in Derbyshire in 1922. During that year, when a wet spring was followed by dry weather in May and June, I observed a badly attacked field and an excellent piece of oats over the hedge, although both had been sown late. The latter land was in high condition and the farmer practised heavy seeding, 8 bushels per acre. I believe that heavy seeding is desirable as a safeguard against frit damage when drilling in April. Malting barley should also be drilled at heavy rates when put in late, as in this case tillering is undesirable: late tillers make an uneven sample.

Another urgent matter is the manuring of meadows, followed by chain harrowing and stone picking. Attention will next be given to cultivations preparatory to drilling mangolds and marrow stem kale, which should be in the ground by the end of the month, and to potato planting. Winter corn not yet harrowed should have this attention, and the nitrogenous top dressings intended for weak crops should be applied without delay. Towards the end of the month grass and clover seeds will be sown in the more forward pieces of spring corn, earlier sowing being desirable, however, when the nurse-crop is wheat. It is a good rule to apply slag when seeding down, whether for long or for short leys, as undoubtedly slag assists towards the establishment of a good clover plant.

Many farmers are still unaware of the important results of recent experiments on methods of sowing grass and clover seeds*; the land should be well but not deeply harrowed before sowing and, if the seed is broadcast, it should be *covered* by harrowing-in with a light harrow. Rolling may be necessary on light soils, but the harrowing-in must not be omitted. Recently a Derbyshire farmer told me that during sixteen years when he had the use of a clover seed drill he never had a missed plant; but that while farming another holding with a smaller acreage of arable land, which hardly justified the possession of a drill, he had found difficulty in obtaining a satisfactory take. There may be other factors contributing to the difficulty in this case, but the value of drilling is emphasised by farmers who have tried this method. With a suitable seed barrel, a cup-feed corn drill may be used, the coulter weights being taken off to prevent too deep penetration.

Charlock seedlings begin to appear in April, and where powdered kainit is to be tried as a means of destruction, it should be applied whilst the plant is in the rough-leaf stage. On land likely to be infested, deep drilling of a late-sown barley crop followed by chain harrowing is an effective means of keeping the weed down. The charlock germinates before the barley, and may be dealt with about a week before the barley blade appears. Deep harrowing would bring up further supplies of charlock seeds and disturb the barley too much.

Moisture.—In spite of the heavy rainfall of the past winter and the consequent wetness of the land, it is necessary to conserve moisture during the cultivations in preparation for root sowing. Soils and subsoils possess only a limited capacity for

* See this *Journal*, Vol. XXIX, pp. 53, 132, 1125 and Vol. XXX, p. 1134.

moisture, and root crops in particular require larger quantities of water than ordinarily reach the roots in the form of summer rain. Pending the main tillage operations, the entire green-crop area should be kept mulched with a surface layer of loose dry soil, under which the soil will dry more steadily and with less tendency to clod formation. Chain harrowing will produce the desired effect, and land so treated will more readily work down to a tilth than it would if left to dry and bake in lumps until the time for final preparation. The crust that sometimes forms when heavy rains follow surface tillage need not be feared, as it is easily reduced by further light harrowing.

The work of tilth formation is best carried out by preparing the land in successive strips, stirring, refining, ridging up, manuring and covering the manure on one strip before proceeding with the next piece of the field. The required depth of mould should be secured by successive operations of gradually increasing penetration.

Last spring I had under particular observation two fields that were being prepared for roots. In one case the land was manured and ploughed during the winter, and in March it received a superficial preliminary stirring. About the end of the month it was gradually refined from the surface downwards with the spring-tooth harrow, then drawn up in ridges to settle; these were later dressed with the chain harrows before sowing with mangolds. The seed came well and the crop, which was liberally fertilised, yielded over 40 tons per acre. In the other case, the spring workings did not begin until April and the first operation was a deep cultivation, which brought up large lumps of damp soil: these baked into clods, which many further workings, aided by dropping weather in May, ultimately reduced to a tilth. The land was ridged up, manured and sown with swedes in May. The swede crop succeeded, yielding about 25 tons per acre, the result being favoured by a wet summer. In a dry May, the plant might have been taken by the fly; but the most obvious result of the error of cultivating deeply at the start was the greatly increased labour of reducing clods, which, as the land was clean, need not have been allowed to form.

Tilth.—In the preparation of land for a root crop, the soil is ordinarily reduced to a loose incoherent and comparatively dry mass of particles and groups of particles. This condition is necessary to allow of the extraction of twitch, the incorporation of fertilisers, and the covering of the seed with an appropriate

depth of fine soil. Refining the soil also aerates it and thereby stimulates bacterial activity. A loose incoherent mass is not, however, a favourable rooting ground for crop plants: the best conditions are not attained until the mass of soil has regained a reasonable amount of coherence, having settled and become moist. The necessary moisture rises from the subsoil.

Potatoes are capable of commencing growth in a tilth that is comparatively dry and loose, as the reserve of moisture in the seed may be drawn upon until the soil has become sufficiently settled and moist. Mangolds, however, germinate and come away badly when drilled on such a seed bed. If the land is clean and has been manured and ploughed in good time, the spring preparations for sowing on the flat may be comparatively simple and shallow. It is, in fact, a considerable disadvantage to attempt to break up the land and reduce it to a tilth. This year, many acres will necessarily be manured in the ridge, and seed will be drilled on ridges that have not had the time necessary for them to become settled and moist before sowing. In this case the assistance of the ridge roller will be valuable. Where the ridges can be manured and split a fortnight before sowing, however, it is good practice to dress them with the chain harrows to remove the clods from the tops of the ridges—where they would be a nuisance at singling time—and to expose the moist and somewhat firm soil in which the mangold seed will germinate well.

Weeds.—Annual weeds in land intended for roots can be considerably reduced by ridging up and chain harrowing before drilling. The presence of twitch (*Agrostis*), however, complicates the method of preparing the seed bed. On heavy soils it is almost impossible to give infested land a thorough spring cleaning without incurring considerable risk of a reduced mangold crop. Bare fallowing is the favourite method of dealing with this pest, during which series of operations the soil is best kept in rough dry clod until after midsummer. In a wet season such as that of 1924, however, even bare fallowing may fail to clean the land. During the later stages of the war when so much land was in foul condition, many farmers attempted bare fallowing who had little experience of the method, and in some cases the final result was a piece of land in worse condition than it would have been if it had grown a crop of corn.

Twitch is kept down by growing heavy corn crops. During 1919, I observed a good illustration of this principle. A farmer who had about 50 acres of his arable land in such a state as

appeared to necessitate bare fallowing did fallow 40 acres; but in one field, which was as foul as the rest, he decided to try a different plan. During April he skimmed the twitchy layer off, worked it about with tine implements until it was somewhat dry, then ploughed it down under a fairly deep furrow. He then applied a heavy dressing of artificial manures and drilled the field thickly with barley. The barley came up quickly and made a dense cover before the twitch revived. The stubble was found to be remarkably free from the weed. In this case the soil was of fairly strong texture, but I have seen the method adopted with success on light land. Docks apparently cannot be smothered; but Mr. J. C. Brown states that he has been able to suppress thistles by growing two smother crops in succession.

Live Stock.—Milk producers contend that in April cows require heavier feeding than in other months to produce the same quantity of milk. There appears to be no experimental evidence in support of this contention, but it is not here disputed. Generally the supplies of succulent food have become rather short, roots have lost some of their digestible contents, and the effects of minor omissions from the diet, such as salt, and mineral deficiencies in the fodder, will have more influence at the end of the winter than at the beginning. Moreover, housed cattle which receive little attention in the matter of grooming often become very uncomfortable owing to skin and hair affections at this time of the year. Cows that have been rather warmly housed during the winter should be gradually hardened during April in anticipation of grass day next month.

While cattle are still indoors the opportunity should be taken to dress their backs to destroy warbles. There are several dressings which if properly applied will kill 80 per cent. or more of the maggots. One that has been very thoroughly tested and found to be both effective against the warble and harmless to the cattle may be prepared by mixing 1 lb. of fresh lime in a gallon of water, adding 4 lb. of tobacco powder, stirring and after standing for 24 hours straining the clear liquid through a cloth. The wash deteriorates on keeping.

April is the month in which the new grazing season begins. Feeding pastures are stocked with large bullocks, dry cows or smaller heifers, according to the known qualities of the respective fields. Dry cows and young cattle other than calves begin to lie out on the second quality pastures during this month, the best dairy pastures being reserved to produce a full bite for the milkers when they begin to lie out in May. Before the

cattle go out the hedges or walls and gates are again looked over and repaired where necessary. Rough old hedges are admittedly best pleached in April while the sap is rising; but the policy of deferring hedge cutting until this month is generally associated with procrastination. Neglected fences are too common a feature of the British countryside, excepting in districts where farming opinion has been cultivated by the activities of local hedge-cutting associations. Some of these societies have accomplished most valuable results.

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MANURES FOR APRIL.

SIR JOHN RUSSELL, D.Sc., F.R.S.,
Rothamsted Experimental Station.

Manuring of Swedes.—The question whether swedes require artificial fertilisers as well as farmyard manure was recently raised at a farmers' meeting. This problem has been made the subject of many field experiments in different parts of the country, and the general result has been that either artificials alone or farmyard manure alone suffice to give crops up to 20 or 25 tons per acre, but a combination of the two gives better results where crops of 30 or 40 tons are obtainable. The growth of swedes is more frequently limited by climatic factors than by fertilisers. In the southern and midland counties, conditions rarely permit of the large crops obtainable in the north of England and in Scotland. In the South Country crops up to the limit of the water supply in the soil can be obtained by the use of some 10 to 12 tons of dung per acre, but only rarely can this be increased by the addition of artificials.

The past season at Rothamsted was very favourable to the growth of swedes, and without artificials the yield amounted to 24 tons per acre. When in addition a liberal dressing of artificials was supplied the yield was pushed up only to 26 or 28 tons according to the dressing; in less favourable years the increases have been smaller. In the numerous seasons in which we have experimented with swedes our crops have varied from 30 tons per acre downwards, but we have not as a rule been able to obtain important additions of crop in good seasons or to save the crop in bad seasons by the addition of artificials to farmyard manure.

A useful mixture of artificials for swedes in the southern and midland counties is composed of 1 cwt. sulphate of ammonia and 4 cwt. superphosphate applied with the seed: as an alternative 10 to 12 tons of dung can be used, but it is not necessary to use both. In the northern counties, where higher yields are obtainable, a combination of both may give good results.

Does Grazing Grass Respond Best to Slag or Bone?—This matter has been discussed a good deal, but unfortunately it is not possible to give a definite answer. In the Cockle Park experiments, slag gave the best results both on the lighter and heavier soils, but the land there is a poor Boulder Clay, very different in character from some of the better grass land of the midland counties. The subject is one as to which further tests might well be made.

Artificial Manures for Hay Land Usually Receiving Dung.—Among questions recently raised at a farmers' lecture was the following:—Could hay land which normally receives dung, be dressed with nitrate of soda alone in a year when no dung is available? No harm could result to hay land treated in this way. The disadvantages of applying nitrate of soda alone is that it furnishes neither phosphates nor potash, both of which are essential to the grass if the best results are to be obtained. Farmyard manure, however, contains a considerable quantity of potash, 10 tons supplying approximately as much as is present in 3 cwt. of muriate or sulphate of potash. Dung also contains phosphate, though as a rule not sufficient for the best development of the herbage. Good results can be expected from the occasional use of basic slag in autumn, followed by nitrate of soda in spring. If farmyard manure has not been given for some time, a dressing of kainit is commonly advantageous in supplying the needful potash and thus ensuring adequate development of the clover.

The Use of Nitrogenous Fertilisers on Pasture Land.—Considerable interest is being taken in the question whether sulphate of ammonia or nitrate of soda should be applied to grazing land. At present the only experimental evidence is that furnished by Cockle Park, and this is not direct evidence but is based on the feeding value of hay from mown land. It is there shown that sulphate of ammonia used alone increased the yield of hay from 19 to 23 cwt. per acre, but it depressed the value of the hay as shown by the feeding results from 80s. to 72s. per ton: the net result was a financial loss of 14s. 5d. per acre. A similar depression in money value was obtained when slag was given in addition.

Slag alone yielded 25¼ cwt. per acre, valued on the basis of feeding trials at 93s. per ton, while slag and sulphate of ammonia gave 29¾ cwt. per acre valued at 24s. per ton; the profit from the slag was 31s. per acre, and from the slag and sulphate of ammonia 17s. 2d. However, grass land differing from that at Cockle Park might well respond differently, and the subject is one on which more experiments are needed before an answer can be given.

Ploughing in of Green Crops.—An interesting result was obtained at Rothamsted last year showing the increased yield obtained by ploughing green crops into the soil before sowing cereals. Mustard had been grown in the late summer of 1923; the crop was ploughed in just before the sowing of oats in October; the yields of oats in August, 1924, were as follows:—

	Bushels per Acre.		
	No other Manure.	5 tons Town Refuse.	10 tons Town Refuse.
Green Manure (Mustard) ...	43.3	51.8	48.8
No Green Manure ...	27.5	29.3	32.8
Balance in favour of Green Manuring	15.8	22.5	16.0

There was thus an increase of 16 bushels obtained in two tests, and 22½ bushels in the third as the result of ploughing in the green crop. The cost of the green crop is not great, and its effect is very striking: a dressing of farmyard manure could hardly have been expected to do better. It is rarely possible to treat much land in this way, but no opportunity should be neglected. Mustard is nearly always suitable: vetches are good in a heavy soil but not in a light one.

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MONTHLY NOTES ON FEEDING STUFFS.

E. T. HALNAN, M.A., Dip. Agric. (Cantab.),
Animal Nutrition Institute, Cambridge University.

The Purchase of Feeding Stuffs for Milk Production.—In constructing a balanced ration for feeding dairy cows, the home-grown feeding stuffs generally supply all the carbohydrates or fats required, but the protein supply is generally deficient. The main reason why the dairy farmer purchases feeding stuffs is to obtain the extra protein the animal requires for milk production, and he therefore requires to know, not simply how much starch equivalent they supply, but how much digestible protein they supply and its relative cost. In order to enable the dairy farmer to compare the relative values of foods from a

DESCRIPTION.	Price per Qr. s. d.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv. s.	Price per lb. Starch Equiv. d.	Per cent of Digest. Crude Protein %
Wheat, British	—	—	13 13	0 16	12 17	71·6	3/7	1·92	10·2
Barley, British Feeding	—	—	10 15	0 12	10 3	71	2/10	1·52	6·5
„ Canadian :—									
No. 3 Western	41/9	400	11 13	0 12	11 1	71	3/1	1·65	6·5
„ 4 „	40/9	„	11 8	0 12	10 16	71	3/1	1·65	6·5
„ American	40/9	„	11 8	0 12	10 16	71	3/1	1·65	6·5
„ Danubian	40/9	„	11 8	0 12	10 16	71	3/1	1·65	6·5
„ Karachi	41/0	„	11 10*	0 12	10 18	71	3/1	1·65	6·5
Oats, English, White	—	—	10 0	0 13	9 7	59·5	3/2	1·70	8·0
„ „ Black and Grey	—	—	9 13	0 13	9 0	59·5	3/0	1·61	8·0
„ Scotch White	—	—	11 0	0 13	10 7	59·5	3/6	1·87	8·0
„ Canadian :—									
No. 2 Western	35/3	320	12 7	0 13	11 14	59·5	3/11	2·10	8·0
Argentine	29/0	„	10 3	0 13	9 10	59·5	3/2	1·70	8·0
Maize, Argentine	42/6	480	9 18	0 13	9 5	81	2/3	1·20	7·1
Beans, English Winter	—	—	11 5	1 12	9 13	67	2/11	1·56	20·1
„ Chinese „	—	—	11 15	1 12	10 3	67	3/–	1·61	20·1
Peas, English Maple	—	—	11 7	1 8	9 19	69	2/11	1·56	19·4
„ Japanese	—	—	24 5†	1 8	22 17	69	6/7	3·53	19·4
Rye, Homegrown	—	—	11 0	0 16	10 4	71·6	2/10	1·52	9·6
Dari, Egyptian	—	—	10 17	0 15	10 2	75·2	2/8	1·43	7·7
„ Persian	—	—	12 10	0 15	11 15	75·2	3/2	1·70	7·7
Millers' Offals :—									
Bran, British	—	—	8 2	1 7	6 15	45	3/0	1·61	10·9
„ Broad	—	—	9 15	1 7	8 8	45	3/9	2·01	10·9
Middlings—									
Fine Imported	—	—	9 15	1 2	8 13	72	2/5	1·29	12·6
Coarse, British	—	—	8 5	1 2	7 3	64	2/3	1·20	11·5
Pollards, Imported	—	—	7 15	1 7	6 8	60	2/2	1·16	11·6
Meal, Barley	—	—	13 0	0 12	12 8	71	3/6	1·87	6·5
„ Maize	—	—	11 12	0 13	10 19	81	2/8	1·43	7·1
„ „ South African	—	—	10 12†	0 13	9 19	81	2/5	1·29	7·1
„ „ Germ	—	—	10 5	0 19	9 6	85·3	2/2	1·16	18·4
„ „ Gluten Feed	—	—	11 0	1 7	9 13	75·6	2/7	1·38	20·0
„ Locust Bean	—	—	9 15	0 9	9 6	71·4	2/7	1·38	4·0
„ Bean	—	—	13 5	1 12	11 13	67	3/6	1·87	20·1
„ Fish	—	—	21 0	4 7	16 13	53	6/3	3·35	50·0
Linseed	—	—	24 10	1 11	22 19	119	3/10	2·05	19·4
„ Cake, English 12% Oil	—	—	14 5	1 18	12 7	74	3/4	1·78	25·3
„ „ 10% Oil	—	—	13 10	1 18	11 12	74	3/2	1·70	25·3
„ „ 9% Oil	—	—	13 5	1 18	11 7	74	3/1	1·65	25·3
Soya Bean Cake 6% Oil			12 0	2 14	9 6	69	2/8	1·43	38·2
Cottonseed Cake, English 5½% Oil	—	—	8 0	1 15	6	42	3/0	1·61	17·6
„ „ Egyptian 5½% Oil	—	—	7 12	1 15	5 17	42	2/9	1·47	17·6
Decorticated Cotton Seed Meal 7% Oil	—	—	12 0	2 14	9 6	74	2/6	1·34	36·3
Ground Nut Cake 7% Oil	—	—	10 17*	1 16	9 1	56·8	3/2	1·70	42·0
Palm Kernel Cake 6% Oil	—	—	9 10‡	1 3	8 7	75	2/3	1·20	17·1
„ „ Meal 2% Oil	—	—	8 7	1 4	7 3	71·3	2/–	1·07	17·1
Feeding Treacle	—	—	7 10	0 8	7 2	51	2/9	1·47	1·1
Brewers' Grains :—									
Dried Ale	—	—	9 17	1 4	8 13	49	3/6	1·87	14·0
„ Porter	—	—	9 7	1 4	8 3	49	3/4	1·78	14·0
Wet Ale	—	—	1 12	0 9	1 3	15	1/6	0·80	4·8
„ Porter	—	—	1 7	0 9	0 18	15	1/2	0·62	4·8
Malt Culms	—	—	8 10†	1 14	6 16	43	3/2	1·70	19·9

* At Bristol. † At Liverpool. ‡ At Hull.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of February and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 3s. per ton. The food value per ton is therefore £8 17s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices:—N, 13s.; P_2O_5, 4s. 2d. K_2O 2s. 6d.

protein-supplying standpoint, a new column has been included in the feeding stuffs table giving the percentage of digestible protein present in the feeding stuffs. By dividing the price per ton of the feeding stuffs by the percentage of digestible protein present, the farmer is enabled to ascertain in a rough and ready way the cheapest foods regarded as sources of supply of protein.

Milk Yield of Cows as Affected by Times of Milking.—Much discussion always arises when the subject of the advantages of frequent milking of cows is mentioned to dairy farmers. The general custom is to milk twice daily, but occasionally dairy farmers, particularly when dealing with heavy yielding cows, will milk three times a day or more. The advocates of frequent milking state that the total milk yield of the cows is increased materially by increasing the number of times of milking. An interesting study on this subject has been carried out at Missouri University by Ragsdale, Turner and Brody. In their experiments, which were extended over a period of three months, they used two Jersey and two Ayrshire cows. As the result of their observations, the conclusion arrived at was that a cow that is milked three times daily will give 110 per cent. of the milk that is given by the cow milked twice daily. If the number of times of milking is increased to four times a day, the yield will be increased to 116 per cent. Thus, on this basis, a cow giving 10 quarts of milk a day when milked twice daily will give 11 quarts if milked three times a day. and 11·6 quarts if milked four times a day. The results of this experiment indicate that where labour conditions can be adjusted to the new routine, milking three or even four times a day will be followed by beneficial results. In a herd giving 100 gallons of milk a day an extra 10 gallons a day is worth striving for.

The Influence of Fats in Feeding Stuffs.—In making up rations for animals, a point that is often overlooked is the amount of fat that is given in the ration. Experiments with adult ruminants showed that an increase of the fat beyond 1 lb. per 1,000 lb. live weight is likely to lead to disturbance of digestion, and the appetite also is likely to be affected. Rice bran is particularly rich in oil, samples often containing as much as 13-14 per cent. of fat, and care should always be exercised in rations including this material, to ensure that the maximum desirable amount of oil is not exceeded. With growing stock and young animals, and also with pigs, up to 2 lb. of fat per 1,000 lb. live weight can be given without any detrimental effect.

FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat - - - - - -	1·20	2 3	71·6	8 1	0 16	8 17
Oats - - - - - -	1·20	2 3	59·5	6 14	0 13	7 7
Barley - - - - - -	1·20	2 3	71·0	8 0	0 12	8 12
Potatoes - - - - -	1·20	2 3	18·0	2 1	0 4	2 5
Swedes - - - - -	1·20	2 3	7·0	0 16	0 2	0 18
Mangolds - - - - -	1·20	2 3	6·0	0 14	0 3	0 17
Beans - - - - -	1·20	2 3	67·0	7 11	1 12	9 3
Milk - - - - - -			17·1			
Good Meadow Hay - -	1·87	3 6	31·0	5 8	0 14	6 2
Good Oat Straw - - -	1·87	3 6	17·0	2 19	0 7	3 6
Good Clover Hay - -	1·87	3 6	32·0	5 12	1 0	6 12
Vetch and Oat Silage - -	1·52	2 10	14·0	2 0	0 7	2 7
Barley Straw -	1·87	3 6	19·5	3 8	0 6	3 14
Wheat Straw - - - -	1·87	3 6	11·0	1 18	0 4	2 2
Bean Straw - - - - -	1·87	3 6	19·0	3 6	0 9	3 15

* * * * * *

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	*Average Price per ton during week ending March 11th.*				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	14. 0	13.17	13. 0	13. 9	17. 4
,, ,, Lime (N. 13 per cent.)	...	12.10	...	12.12	19. 5
Sulphate of Ammonia, ordinary (N.20.7 per cent.)	13.11*	13.11*	13.11*	13.11*	(N)13.1
,, ,, ,, neutral (N. 21.1 per cent.)	14.14*	14.14*	14.14*	14.14*	(N)13.11
French Kainit (Pot. 20 per cent.)	3.0	3. 0	...	2.12	2. 7
,, ,, (Pot. 14 per cent.)	2.15	2.15	2. 7	2. 7	3. 5
Potash Salts (Pot. 30 per cent.)	...	...	3.17	3.15	2. 6
,, ,, (Pot. 20 per cent.)	...	...	2.17	2.10	2. 6
Muriate of Potash (Pot. 50 per cent.) ...	8.5	7.10	7. 5	7. 0	2.10
Sulphate of Potash (Pot. 48 per cent.) ...	12.10	11.15	11.10	11.10	4. 9
Basic Slag (T.P. 30 per cent.)	3. 2§	...	2.12§	2.12§	1. 9
,, ,, (T.P. 28 per cent.)	...	2. 1‡	...	2.10§	1.10
,, ,, (T.P. 26 per cent.)	...	1.14‡	...	2. 8§	1.10
,, ,, (T.P. 24 per cent.)	...	1.11‡	2. 0§	2. 6§	1.11
Superphosphate (S.P. 35 per cent.) ...	...	...	3.15	3. 8	1.11
,, (S.P. 30 per cent.) ...	3. 7	3. 5	3. 8	3. 2	2. 1
Bone Meal (N. 3¼, T.P. 45 per cent.) ...	9.10	8.10	8.10	8. 5	...
Steamed Bone Flour (N. ¾, T.P. 60 per cent.)	7. 0†	7. 7†	6.10	6. 7†	...
Fish Guano (N. 7½-8¼, T.P. 16-20 per cent.)	...	...	13. 0	...	...
,, ,, (N. 9, T.P. 10 per cent.) ...	...	...	...	12.10	...
Burnt Lump Lime	1. 8	1.17	1.18	2. 2§	...
Ground Lime	1.14	2. 7	2. 8	1.16§	...
Ground Limestone	1. 1	...	1. 4	1. 5§	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ F.o.r. Works.

§ Prices include cost of carriage from works to town named, and at London are for not less than 4-ton lots. Cost to purchasers in other districts will be greater or less according to the distances of different purchasers from the works.

MISCELLANEOUS NOTES.

Clean Milk Competitions in the North of England.

Two clean milk competitions, each covering a wide area in the north of England, were held in 1924. One of them, covering the three Ridings of Yorkshire, was organised by the Yorkshire Agricultural Society in co-operation with the Yorkshire Council for Agricultural Education. The other was organised by Armstrong College, Newcastle-on-Tyne, in conjunction with the Local Education Authorities of the four counties concerned, viz., Cumberland. Durham, Northumberland and Westmorland.

Yorkshire Competition.—The Yorkshire competition, which attracted 18 entries. extended over a period of four months, commencing on 14th February and ending on 14th June, 1924. thus including two cold and two warmer months; and prior to its commencement. arrangements were made for two members of the University Staff to visit and advise competitors as to the methods necessary for clean milk production. Twelve competitors availed themselves of the offer.

The system of awarding marks was similar to that detailed in the Ministry's Guide* and included inspection on the farm and the examination of milk for bacteria, keeping qualities, and fat content. Eight samples of milk were taken from each competitor, seven samples of morning's milk being submitted by competitors themselves and one surprise sample of afternoon's milk being taken by the inspecting judge on the occasion of his official visit. Generally there was a very close agreement between the bacterial counts of the competitor's own samples, and that of the surprise sample. In regard to the testing of these samples it is of considerable interest to note that 5 competitors out of 18 had 100 per cent. of their samples within the standard laid down for Grade A milk, 4 competitors 87.5 per cent., 1 competitor 75 per cent., and 4 competitors 62.5 per cent. In addition, of the total samples submitted, 77.2 per cent. reached the standard required for Grade A milk. and the average sample kept perfectly sweet and untainted for 3½ days. These figures demonstrate that the competition was effective in educating the competitors in the meaning and value of clean methods.

A Challenge Cup provided by the Olympia Oil and Cake Co., Ltd. was awarded. This cup has to be won three times including twice in succession to become the personal property of the

* *Miscellaneous Publications*, No. 43, "Guide to the Conduct of Clean Milk Competitions," price 6d. net, post free.

winner. In addition, certificates were given to six competitors and their regular milkers who reached a sufficiently high standard. Money prizes were given to the employees on the farms of the leading four competitors.

This competition, in common with others held in different parts of the country, serves to confirm the view that in the production of clean milk, methods are of more importance than expensive buildings and elaborate machinery. It shows that the chief essential is attention to detail, until a satisfactory routine of clean methods has been established; and, further, that an intelligent interest must be shown by farmers and their employees.

Four Northern Counties Competition.—In the case of the Armstrong College competition, a series of clean milk demonstrations on farms had been given previously. It was found that this work was fruitful in producing a much better understanding of the essential conditions for clean milk production. The competition commenced on 1st March, 1924, and lasted five months. There were 40 competitors (Northumberland 17, Cumberland 17, Westmorland 4 and Durham 2) and this number would undoubtedly have been much greater had it not been for serious outbreaks of foot-and-mouth disease in the area shortly before the competition commenced.

The awards were based on a scale of points approximating that subsequently recommended in the Ministry's Guide, attention being given to the bacterial and chemical composition of the milk, the general health of cows, methods of milking and general management, and the condition of byres and buildings so far as they were directly under the control of the competitor. Competitors were required to send to Armstrong College samples of milk for bacteriological and chemical examination on request; such requests were sent at irregular intervals and only short notice was given. Each farm was visited at least twice, and in most cases three times, by the inspecting judges, and on these occasions surprise samples of milk were taken.

249 samples were examined of which 166 were submitted by farmers and 83 were taken by the inspecting judges. From the following statement it will be seen that more than half the samples submitted were of a standard above Grade A.

Standard Reached.	*Number of Samples.*	*Percentage.*
Certified	90	36.14
Grade A	49	19.67
Below Grade A	110	44.17

A Challenge Cup was awarded to the winner of the competition and a silver medal to the second competitor. Two competitors were placed equal for the third place, each of them receiving a bronze medal. Certificates were awarded to the ten leading competitors, whose work reached an exceedingly good standard. Printed recognitions were given to the workers on these farms, and money prizes were awarded to the employees on the four prize-winning farms. The prizes to farmers and certificates to workers were given by the National Milk Publicity Council.

In the reports on the competition it is stated that whilst with few exceptions the methods employed by the competitors at the beginning of the competition were not good, many improvements were noticed when the final inspections were made. Milking machines were in use on three farms, but in no case were the results so satisfactory as on those farms where clean hand-milking was practised. It is again reiterated that it was only on those farms where not only were the buildings clean, and the utensils properly sterilised, but where the milkers were all keen and painstaking in their methods, that good results were obtained; and that whilst the importance of suitable cowhouses and buildings must not be underestimated, milk up to the standard of Certified Milk was produced on farms where the buildings must be classed as inferior.

Full reports on both these competitions have been issued: (1) "Clean Milk in Yorkshire," by the Yorkshire Agricultural Society, and (2) "Clean Milk Competition, 1924," by the Agricultural Department of Armstrong College. These reports are very full and instructive, and a wide distribution has been made. That they have aroused considerable interest is evidenced by the generally expressed desire that further competitions should be held in 1925, and arrangements are in hand for the movement to be continued and extended.

* * * * * *

The Agricultural Index Number.

THE general level of the prices of agricultural produce during February was 67 per cent. above those ruling in the corresponding month of 1911-13. The index number therefore shows a decline of 3 points as compared with January, but is 6 points higher than in February of last year. The rise as compared with last year is due to wheat, barley, sheep and pigs, most other commodities being cheaper now than a year ago.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.	1925
January ...	200	183	75	68	61	70
February ...	195	167	79	63	61	67
March ...	189	150	77	59	57	—
April ...	202	149	70	54	53	—
May ...	180	119	71	54	56	—
June ...	175	112	68	51	58	—
July ...	186	112	72	53	52	—
August ...	193	131	67	54	59	—
September	202	116	57	56	60	—
October ...	194	86	59	51	63	—
November	193	79	62	53	64	—
December	184	76	59	56	63	—

Wheat averaged 8d. per cwt. more than in January, and the index figure advanced to 83 per cent. above pre-war, so that wheat was relatively the dearest grain and was making comparatively higher prices than most other commodities. Barley prices dropped sharply, though the decline would be occasioned to some extent by a larger proportion of the sales being of feeding qualities. Oats were slightly dearer than in January, but the rise was relatively smaller than in the basic years and the index figure was reduced by 4 points.

All classes of fat stock sold at higher rates on the month, but the rise of ½d. per lb. in the case of sheep was not so sharp as in pre-war years and the index number for these declined. The advance in fat cattle was 3d. per 14 lbs. stone, while bacon pigs rose by 7d. per stone and porkers by 4d. per stone. The index figure for fat pigs has risen each month since July, 1924, and is now 61 per cent. above 1911-13 against only 31 per cent. eight months ago.

The demand for dairy cattle has not been brisk, as the mild weather has conduced to the flow of milk being well maintained, and on the average cows sold at about 15s. per head less than in January. All classes of store stock became dearer last month, but the rise in pigs and sheep was relatively not quite so large as in 1911-13.

Butter averaged 2d. per lb. less than in January, and was 1¼d. per lb. cheaper than in February, 1924. Eggs also realised less money than a year ago, the decline in February being much sharper than last year and in the basic years, and the index number fell by 20 points. Cheese was 2s. 6d.

per cwt. dearer than in January, but the index number rose by 1 point only. Milk was unchanged on the month.

Prices of potatoes became rather easier during February, the average fall being about 5s. per ton, and for the first time for many months the index number is lower than a year earlier. The index number of other vegetables declined by 7 points to 74 per cent. above pre-war. Carrots remained very cheap at 27 per cent. above 1911-13, and cabbage declined on the month to only 40 per cent. above pre-war. Celery remained unchanged at rather over double the price in the basic years, and cauliflowers, though 5d. per dozen cheaper than in January were 2¼ times the pre-war price. Brussels sprouts advanced by 1s. 2d. per cwt. and at 62 per cent. above 1911-13 were 11 points up on the month, and onions rose sharply to 81 per cent. above the price in the basic years.

Index numbers of different commodities during recent months and in February, 1923 and 1924, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	1923.	1924.			1925.	
Commodity.	Feb.	Feb.	Nov.	Dec.	Jan.	Feb.
Wheat ...	28	44	68	67	76	83
Barley ...	12	43	89	76	81	59
Oats	39	41	45	37	46	42
Fat cattle ...	61	54	47	44	52	53
Fat sheep ...	97	75	90	84	107	100
Fat pigs ...	88	34	45	49	59	61
Dairy cows ...	67	48	60	55	53	50
Store cattle ...	36	39	36	37	43	46
Store sheep ...	100	89	94	85	102	100
Store pigs ...	154	50	33	38	49	48
Eggs... ...	46	75	84	51	82	62
Poultry ...	80	52	62	64	63	56
Milk	90	87	82	84	84	84
Butter ...	72	71	74	73	73	62
Cheese ...	88	72	38	51	49	50
Potatoes ...	—5*	170	168	166	152	144
Hay	42	—1*	1	2	1	0

* Decrease.

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Veterinary Tests for Poultry Diseases.

THE Ministry announces that owing to the increasing number of poultry submitted to the Ministry's Veterinary Laboratory for post-mortem or other examination, it has been found necessary to appoint a special officer to undertake this examination work. It has also been decided to institute a scale of fees to be charged as from 16th March last.

The charge for an ordinary post-mortem examination will be 3s. a bird. In the case of flocks suspected of being infected with Bacillary White Diarrhœa, an inclusive fee of 10s. is payable, in respect of whatever number of tests are required to establish, or otherwise, the existence of the disease in the flock. In all cases where a number of chicks have died it is desirable that several should be sent for examination. In flocks where this disease is found the remaining birds will be tested for elimination purposes at an additional fee of 1s. a bird. In all cases fees are payable in advance.

Special terms will be allowed where birds are submitted in numbers (*e.g.*, from egg-laying competitions) for post-mortem examination or for the agglutination test for bacillary white diarrhœa. Particulars may be obtained from the Ministry's Veterinary Laboratory, New Haw, Weybridge. (Station: Addlestone, S.R.). Birds submitted for post-mortem or other examination should be sent direct to that address, carriage paid, accompanied by the necessary remittance, and accompanied by the name and address of the sender. Postal orders, etc., should be made payable to "The Ministry of Agriculture and Fisheries" and crossed "& Co."

*   *   *   *   *   *

Amendment of the Canadian Seed Importation Regulations.

ARTICLE 6 of the Canadian Seed Importation Regulations, which was in operation up to 1st October, 1924, provided that shipments of seeds marked with a grade, or, in the case of field root and garden vegetable seeds, with the percentage of germination, might be released by the Collector of Customs without delay if a Canadian Government Seed Laboratory test number was given as authority for grade or percentage of germination stated. It is understood that few importers availed themselves of the facilities for getting a Canadian test made before shipment, so that, in most cases, imported lots had to be held up by the Customs until an official test was completed. The delay in the delivery of imported seeds caused in this way, is said to have

seriously handicapped business, and in order to meet these difficulties the Canadian authorities have now amended Article 6 to read :—

"Delivery without examination or bond.—The Collector of Customs may, after taking a sample for test, deliver shipments of seed to consignees without further examination or bond: (1) when the invoices are accompanied by a certificate issued by an official seed testing station, of any country or state, which official seed testing station has been approved by either the Association of Official Seed Analysts of North America or the International Seed Testing Association, showing the percentage of pure living seed and the proportion of weed seed to conform to the minimum standards required for the kind of seed under the Seeds Act and regulations; or, (2) when the invoices or containers are marked with a control sample certificate number from a Canadian seed inspection office showing that the seed conforms to the minimum standards required for the kind of seed under the Seeds Act and regulations, and including: (*a*) for seed imported under grade, the name of the grade of seed and the serial number of the certificate; (*b*) for seeds of rape, field roots and garden vegetables, the serial number of the control sample certificate.

"The privilege hereby extended of delivering seed without examination or bond may be withdrawn at any time by the Minister if the imported seed does not within the limits of reasonable variation conform to the control sample that is held by the official seed testing station which issued the certificate that is attached to the invoice or container."

The Seed Testing Stations in Europe whose tests are valid for the purpose of this regulation are as follows: England (Cambridge); Scotland (Edinburgh); Ireland (Dublin, Belfast); Denmark (Copenhagen); Norway (Trondhjem); Sweden (Orebro): Germany (Hamburg, Munich, Breslau); Holland (Wageningen); Belgium (Louvain); France (Paris); Switzerland (Zurich); Austria (Vienna); Czecho-Slovakia (Prague); Hungary (Budapest); Roumania (Bukarest); Italy (Bologna); Finland (Helsingfors).

* * * * * *

Exchange of British and Danish Agriculturists.

LAST year the Ministry arranged, through the Agricultural Commissioner of the Danish Government, for a limited number of young agriculturists from this country who were desirous of securing practical experience of Danish agriculture, to be placed for work on farms in Denmark. Similarly, arrangements were made for an equal number of young agriculturists from Denmark to be placed on farms in this country. Approved applicants were required to pay their own travelling expenses to and from their destination, and to undertake regular work on a farm, for a period of from three to six months, in return for free board and lodging. No money was payable to them.

On the whole the scheme worked satisfactorily, and it has therefore been decided to continue it, on the same lines, during 1925. The National Farmers' Union is giving assistance in the selection of farms where Danish agriculturists may be received, and in securing suitable British applicants for placing on Danish farms. Applications from young agriculturists in this country may be sent to the Ministry of Agriculture, and will be transmitted to the Danish Agricultural Commissioner.

* * * * * *

Prohibition of Importation of Potatoes from Canada.

IT will be remembered that in December last the Ministry felt it necessary to prohibit the importation into England and Wales of potatoes grown in the United States in order to guard against the importation into this country of the destructive Colorado Beetle with which the potato fields over large areas of the States are infested. It was recognised at the time that consideration would have to be given to the necessity for similar action in regard to potatoes grown in Canada, and inquiries were accordingly made as to the prevalence of the Colorado Beetle in the potato-growing districts of the Dominion. It appears as a result of these inquiries that the continued importation of Canadian potatoes involves a risk of the introduction of the beetle into this country, and the Ministry has accordingly issued the Colorado Beetle Order of 1925 prohibiting the importation into England and Wales of potatoes grown in Canada. The Order came into operation on 20th February, but provision was made for the admission of any consignments shipped before that date.

* * * * * *

Vaccination of Animals against Tuberculosis.

THE Ministry has recently undertaken to test a special method of vaccination of animals against tuberculosis. The vaccine used in the test is the result of many years of work by two distinguished scientists, Dr. Calmette and M. Guerin. It is not claimed by them that the vaccine is an effective preventive, but merely that the promise of preliminary experiments entitles it to a trial in the field of practice—a trial which is unlikely to be completed in less than five years. The Ministry does not hesitate to say that it is unable at present to encourage those farmers who are at the present time considering the use of a vaccine in the belief that a solution of the problem has been reached. With regard to the trials conducted by the Ministry, the material for the vaccine costs only a few pence

per dose, and is being issued, in those cases which are selected for trial, free of charge.

These facts should be borne in mind by stock-owners, should they be recommended to use any vaccines against tuberculosis which have not been fully tested out in practice. In this connection, it should be remembered that all attempts in the past to immunise animals against tuberculosis with killed bacilli have definitely failed in their purpose. The Calmette-Guerin vaccine which the Ministry is trying out is a living one.

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Poultry for Improving Poor Pastures on Light Soils.

THE Ministry's attention has been drawn to a striking illustration of the value of running poultry on poor pastures on light soils. This occurred on a manurial demonstration plot which was one of a series arranged by the Agricultural Education Sub-Committee of the Worcestershire County Council. The soil consisted of sandy to gravelly loam over a sandy to gravelly subsoil. The turf was comparatively young and the chief grass hard fescue with, mainly, bent, Yorkshire fog and sweet vernal; cocksfoot and perennial ryegrass were also present. The leguminous species included minute plants of white clover and narrow-leaved vetch. Composite weeds were abundant and also mouse-ear chickweed, sorrel and moss. At one end of the field a large flock of poultry with free range has been fed for two seasons. The change which has been effected in the composition of this rather singular type of mixed herbage has been remarkable. Where the poultry congregated most, white clover has increased to such an extent that it has almost blotted out all other plants. A diminishing effect is observable as the range widened. In this way, a good method of improving poor pastures on light soils has been strikingly demonstrated at this centre which is well worth consideration in other suitable cases.

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Egg and Chick Distribution Scheme, 1925.

A SCHEME has been in operation in the early part of the year for several seasons now to assist county education authorities in the distribution of sittings of eggs and day-old chicks, with the object of improving the breed of poultry kept by the smaller poultry-keepers and cottagers in rural districts.

The main points of the scheme are the approval and regular inspection of stations from which sittings of eggs and day-old chicks at a specified and moderate price are supplied to applicants

resident within the county. The owners of these approved stations, called " station-holders," are appointed for the season and receive a small subsidy in addition to the price for eggs or chicks paid by the purchaser. It is a condition that the poultry stock at the station shall consist of pure-bred birds of good utility quality, and it is the duty of the County Poultry Instructor to select the stock of a station and to mark it. When the station has been approved, the management of the birds and the manner in which the work of distribution of eggs and chicks is carried out are put under the general supervision of the County Poultry Instructor.

The prices fixed by county education authorities for sittings of eggs now range between 3s. 6d. and 7s. a dozen, and for day-old chicks, 7s. to 14s., with an additional charge for carriage and box when sent by rail or post. In order to encourage a higher standard of stock at the stations this year, higher prices and premiums than in previous years are being allowed for eggs and chicks from selected trap-nested hens. The details of the prices and premiums are as follows :—

(a) *Non-trap-nested Stock.*—3s. 6d. to 5s. per dozen eggs, 7s. to 10s. per dozen chicks and ducklings. Premiums : 1s. 6d. per dozen eggs, 3s. per dozen chicks or ducklings.

(b) *Trap-nested Stock.*—5s. to 7s. per dozen eggs, 10s. to 14s. per dozen chicks and ducklings. Premiums : 2s. 6d. per dozen eggs, 5s. per dozen chicks or ducklings.

The station-holders are recognised under either (a) or (b), but not under both. The season for the distribution of sittings of eggs will last up to 30th April and for chicks up to 15th May.

It is interesting to record the increasing popularity of this scheme. Taking the last six completed years, the figures show that the number of stations has increased from 163 in 1919 to 316 last year, whilst the number of eggs has increased from 52,980 in 1919 to 107,960 in 1924, and the number of chicks from 2,974 in 1919 to over 49,000 in 1924. Orders for eggs and chickens, together with the necessary remittance, should be sent direct to a station-holder. The addresses of station-holders, together with full particulars of the county scheme, may be obtained on application to the Agricultural Organiser in those counties which have adopted the scheme. No doubt those requiring eggs or chicks will see to it that they send to the nearest station-holder and will give their full names, addresses, and nearest railway station. They should always endeavour to arrange for delivery by hand if possible, in order to avoid risk of delay or rough handling in transit.

Demonstrations in Modern Agricultural Practice.

THE Ministry has suggested to local education authorities that a system of demonstration work which is now undertaken in a few counties might, with advantage, be extended to all. These demonstrations are designed simply to exhibit the best modern practice, in one definite matter and on a fairly large scale, to farmers in a district where that practice is not known, or at least not generally adopted. The demonstrations would thus be limited to certain specific points which can be brought out clearly and without risk of confusion. Such questions, for example, as the application of North African phosphate, or an increased application of certain artificial manures, to arable land, or the use of improved seeds mixtures in pastures, or of improved varieties of wheat, oats, barley, etc., or the spraying of charlock could, it is thought, be taken up with very considerable advantage, particularly in the more backward districts. It will be especially useful if in those cases where merely a change of practice is to be demonstrated, the ordinary practice can also be shown side by side with the new practice. Where possible, all demonstrations in one county will be shown on the same farm.

It is understood that the suggested extension of this type of demonstration work, either in place of, or supplementary to, the existing county demonstrations and experiments, is being considered with favour in many counties.

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Farm Workers' Minimum Wages.

A MEETING of the Agricultural Wages Board was held on 10th March, at Gwydyr House Annexe, Whitehall, S.W.1, the Chairman, Lord Kenyon, presiding.

The Board considered notifications from various Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and proceeded to make the necessary Orders carrying out the Committees' decisions, and specifying the date from which the rates should become effective; the date specified being 16th March in each case (except where otherwise mentioned below).

The rates thus fixed are, in the case of male workers 21 years of age and over, as follows:—

Cornwall.—For nine months, 31s. for 51 hr. Overtime at 9d. per hr. on weekdays and 10d. per hr. on Sundays.

Devon.—For three months, 32s. 6d. for 50 hr. Overtime at 8½d. per hr. on weekdays and 10d. per hr. on Sundays. (The operation of the overtime rates is deferred until the Committee have defined overtime employment.)

Lancashire: *Southern Area.*—Stockmen and teamsmen, 37s. for 52½ hr.; other adult male workers, 33s. 6d. for 50 hr.
Eastern Area.—42s. for 60 hr.
Northern Area.—Stockmen and teamsmen, 40s. for 60 hr.; other adult male workers, 37s. 6d. for 60 hr. Overtime in each area 1s. per hr.
Monmouth.—For twelve months, 32s. for 50 hr. in summer (first Monday in March to the day before first Monday in Nov.) and 48 hr. in winter (the remainder of the year). Overtime at 9½d. per hr. on weekdays and 11½d. per hr. on Sundays.
Northumberland.—Until 12th May, 1926, stewards, horsemen, cattlemen, stockmen or shepherds hired by the week or longer, 41s. for customary hr. in the case of such workers who are householders, and 38s. for workers who are not householders. (A week of customary hr. is defined as meaning not exceeding 62 hr.) Other male workers (except casual workers), 34s. for 48 hr. in winter (the Monday following the last Sunday in Oct. up to the Sunday previous to the first Monday in March), and 52½ hr. in summer (the remainder of the year). Male casual workers, 7½d. per hr. Overtime (except for casual workers), weekdays at time-and-a-quarter, Sundays at time-and-a-half.
Somerset.—Until 29th September, 1925, 32s. for 52 hr.
Carmarthen.—Until 14th Nov., 1925, 30s. for a seven day week of 54 hr., with overtime at 8½d. per hr.
Glamorgan.—Until 1st March, 1926, 37s. 6d. for 53 hr. in summer (1st March to 31st Oct.) and 51 hr. in winter (the remainder of the year). Overtime at 10d. per hr. weekdays and 11d. per hr. Sundays.

The above 8 Orders complete the bringing into operation under the Agricultural Wages (Regulation) Act, 1924, of minimum rates of wages for all classes of male workers employed in agriculture throughout England and Wales, the rates for the areas of the other 39 Agricultural Wages Committees being already in force.

The above Orders all include minimum rates for male workers under the age of 21, and also, except in the case of Somerset, for female workers. The principal rates for female workers are:—

Cornwall.—Aged 20 and over, 5d. per hr.
Devon.—Aged 20 and over, 5d. per hr.
Lancashire.—Aged 18 and over, 6d. per hr.
Monmouth.—Aged 17 and over, 6d. per hr.
Northumberland.—Aged 18 and over, other than casual workers, 5d. per hr.; casual workers, 3d. per hr. Overtime, 1d. per hr. more.
Carmarthen.—Aged 18 and over, 5d. per hr. for 8 hr. per day. Overtime at 6d. per hr.
Glamorgan.—Aged 18 and over, 6d. per hr. for 8½ hr. per day. Overtime, 7d. per hr. on weekdays and 7½d. per hr. on Sundays.

The Board also made the following Orders for areas for which rates were already in operation:—*Gloucester*: Minimum rates of wages for carters, shepherds and stockmen under 21 years of age, together with an amended Sunday overtime rate for adults of those classes and overtime rates for all male workers under 21

Holland: An Order continuing the operation of the minimum rates already in force (which are due to expire on 5th April) up to 31st October, 1925, the only amendments being that the weekly minimum rates will be payable as from 5th April in respect of a week of 52 hr. instead of 48 hr. as at present, and an addition of 1s. per week to the special payments for cattlemen and shepherds. *Shropshire*: An Order cancelling the present rate for male workers for time in excess of 54 hr. and under 57 hr. and fixing overtime rates for all time in excess of 54 hr.; the overtime rates for male workers aged 21 and over being 8d. per hr. for employment in excess of 54 hr. and under 60 hr., and 9d. per hr. for employment in excess of 60 hr., and for all employment on Sundays.

Copies of the Orders in full can be obtained on application to the Secretary of the Agricultural Wages Board.

The next meeting of the Board will be held on Wednesday, 25th March, 1925.

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Sugar-Beet Industry.

THE Ministry desires to point out to farmers within a working radius of the existing beet-sugar factories, and of those in course of erection, that these factories require a further contracted acreage in order that, with the assistance of the subsidy now to be granted on sugar produced, they can make an effective start in establishing the sugar-beet industry in this country on a broad and stable basis and justify the large expenditure of capital to which the manufacturers stand committed.

The subsidy scheme has been designed in the belief that the beet-sugar industry will prove of great national value, but the success of the scheme necessarily depends on the support of the farming community. The Ministry feels, therefore, that having regard to the fact that the prices offered to the farmers for their beets have received the approval of the National Farmers' Union and are likely to ensure a reasonable return on the costs of production, every farmer should give serious consideration to the introduction of sugar-beet cultivation into his farming programme.

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AGRICULTURE ABROAD.

American Institute of Co-operation.

THE first session of the American Institute of Co-operation, the formation of which was referred to in this *Journal* for November last, p. 703, has been announced to take place at the University of Pennsylvania, Philadelphia, from 20th July, to 15th August, 1925.

The object of the Institute is to provide a source from which members, employees and officers of co-operative marketing

organisations, teachers of marketing in universities and colleges, public marketing officials and private and public research workers will be able to secure training. Practical experience and knowledge will be pooled for mutual benefit and the advancement of sound co-operation.

The staff of the Institute will include picked men from a wide range of co-operative organisations and from the leading educational institutions. In addition, several authorities of international reputation will attend from Europe.

The topics for study at the first session have been settled as follows:—

First Week: Economic Principles and Legal Structures of Co-operation.

History of Co-operation.	Possibilities and Limitations.
Ideals of the Movement.	Status of State and Federal Legislation.
Development of Types.	Education in Co-operation.

Second Week: Organisation and Membership Problems.

Preliminary Market Surveys.	Patronage Costs.
Forms of Organisation.	Educational Work with Members.
Organisation Finance.	The Co-operative and the Community.

Third Week: Operating Methods and Management Problems.

Source of Personnel.	Warehousing
Business Practices.	Grading and Standardisation.
Auditing and Accounting.	Methods of Pooling.
Marketing Finance.	

Fourth Week: Sales Policies and Price Problems.

What is Meant by Orderly Marketing?
Selling Plans for Principal Commodities.
The Development of Markets.
Price Objectives of Co-operatives.
Selling Problems.
Credits and Collections.
Effect of To-day's Price on To-morrow's Production.

The project is said to have the backing of organisations representing over two million American farmers and to be officially recognised by State Departments of Agriculture, State Bureaux of Markets, and the Federal Department of Agriculture at Washington.

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New Australian Agricultural Research Institute.

THE Waite Agricultural Research Institute has been established by the University of Adelaide for the purpose of conducting investigational and research work in agriculture. The establishment of the Institute was rendered possible by the magnificent gift of the late Mr. Peter Waite, a sheep farmer of South Australia who bequeathed £100,000 to the University of Adelaide for agricultural

research. The Government of South Australia has supplemented the bequest by an appropriation equal to the annual value of the endowment, namely, £5,000 per annum. The Institute is located at Glen Osmond, 3½ miles from Adelaide on an area of 300 acres of good agricultural land. With the funds available it is proposed to conduct investigational work in agronomy, agricultural chemistry, plant pathology and plant genetics.

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Expenditure of the U.S.A. Department of Agriculture, 1924-5.

IN the "Experiment Station Record" for July, 1924, appeared an account of the funds provided by Congress for the use of the Department of Agriculture during the year ending 30th June, 1925. The total sum provided for agriculture was \$51,936,000 (at \$4.60 to the £, approximately £11,290,000) compared with \$55,447,000 for 1923-24. A number of further items of expenditure, however, were approved by both Houses of Congress, but the Bills failed to pass before the close of the Session. These included \$3,500,000 (£760,000) for foot-and-mouth disease. It is stated that taking all these factors into account the ultimate total provision for the work of the Department seems certain to be somewhat in excess of that of any previous fiscal year.

The main divisions of the Department's work and the funds provided for them were as follows (at \$4.60 to the £) :—

	£
Office of the Secretary	1,459,000
Weather Bureau	440,000
Bureau of Animal Industry	1,636,000
Bureau of Plant Industry	802,000
Forest Service	1,735,000
Bureau of Chemistry	302,000
Bureau of Soils	85,000
Bureau of Entomology	449,000
Bureau of Agricultural Economics ...	940,000
Bureau of Biological Survey	194,000

The programme being carried out by the Department during the year is largely a routine one. The principal items of increase are, as a rule, in connection with the regulations enforced by it or for the enlargement of control work directed against particular pests and diseases. The commencement of comparatively few new research projects is authorised, and the Department's prevailing policies and schemes will be continued without material modification.

NOTICES OF BOOKS.

Crop Production in India.—(Albert Howard, C.I.E., M.A., Oxford University Press, 10s. 6d. net.) This book deals with the problems which present themselves to farmers, and to those engaged in agricultural research in India. It has been written with the idea of enlisting the interest of the general public in these problems, and in the measures that are being taken to solve them; it has the subsidiary purpose of encouraging this work, and attracting to it a number of active and enthusiastic investigators.

It is divided into three sections, the first of which deals with the soil, the second with the crop, and the third with the organisation of research work. A good deal of emphasis is laid upon the place of agriculture in the economics of India, because, as the writer correctly says, agriculture will be the primary industry of India for many years yet to come, and it is of the utmost importance that the necessary research work should be done to enable the best results to be obtained by those engaged in the industry.

In all tropical countries the problem of primary importance to agriculture is that of dealing with the water supply, and this problem presents itself no less in India than elsewhere. By quoting a series of examples of damage resulting from the heavy rainfall during the monsoons, and the local and comparatively small adoption of systems of conservation of the water supply, the writer explains these problems. He points out that surface drainage is of the utmost importance because the "run off" erodes the fertile soil,and has in some parts destroyed the agricultural value of many thousands of acres by the creation of deep ravines extending in a network about the main channel of a river. The wealth of water is thus not only valueless, but actually harmful, and must be dealt with before the results of crop research can be of real service to the agricultural population.

Mr. Howard examines the work, which has so far been done on each crop cultivated in the peninsula, and he provides a bibliography covering each section of this work for the benefit of those readers of his book whose interest may be sufficiently aroused.

Part three of the book deals with the organisation of research work, and makes a comparison of the methods of finance and organisation in different countries, but, although he makes tentative suggestions, the writer might possibly have explored this part of the subject more fully.

Farmers and the C.W.S.—(Published by the Co-operative Wholesale Society, Ltd., 118, Corporation Street, Manchester.) This is an interesting booklet which aims at demonstrating the advantages of inter-trading between the agricultural and industrial co-operative movements. The latter, to quote the booklet, "with its experience, numbers and power, holds out its hand to British agriculture. It invites co-operative farmers, as essential producers and consumers themselves, to share in the commerce and in the mind and spirit of British co-operation."

Practical Buttermaking.—C. W. Walker-Tisdale, F.C.S., and Theodore R. Robinson, F.S.I. London: The Swarthmore Press, Ltd., price 3s. 6d. net.) This book is usually regarded as one of the standard works on buttermaking, as carried out on the farm. Formerly it contained a section devoted to "Buttermaking at the Creamery,"

as mentioned on page 111, and it is to be regretted that this section has now been dropped.

The illustrations are excellent, the book is well arranged and altogether should prove very useful to the student attending either a travelling dairy school or a dairy course at a farm institute, etc., and still more useful to those who cannot attend either.

The Agricultural Situation.—(G. F. Warren and F. A. Pearson. New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1924. Price 15s.) This admirable book makes an important contribution to the study of the economic causes underlying agricultural prosperity or depression. Although it is concerned primarily with conditions in the United States, the subject is treated broadly and the general economic conditions are applicable to agriculture wherever it is practised.

The greater part of the book is concerned with the study of American agriculture during the decade following the year 1914, that is to say, during a period of acute economic disturbance in which the general level of prices was first rising rapidly and then falling still more rapidly. The price movements of all the primary products of agriculture are studied individually and illustrated diagramatically during the inflation period, and deflation period respectively. The relation of farm prices to the prices of commodities the farmer had to buy are similarly examined, as also is the course of taxation, bankruptcios, and other economic factors reacting upon the welfare of agriculture. A valuable chapter deals with the indirect consequence to agriculture of monetary instability, and a further chapter refers to other agricultural depressions, showing how much the variations in the purchasing power of money have been responsible for the periods of depression which occurred in the earlier part of the 19th century.

The book once more provides a demonstration, admirably supported by statistical tables and diagrams, of two facts which happily are now being written about and understood much more widely than hitherto: firstly, that the agricultural depression which began in 1920 was brought about primarily by monetary causes; and secondly, that in previous periods of depression monetary causes have played an important if not predominating part. To agriculture unstable money is disastrous.

When they turn to the probable future course of prices, a subject of supreme importance to agriculture, the authors are perhaps on more debatable grounds. On this matter they are pessimistic. Their considered opinion is that the general level of prices will gradually fall owing to an inadequate supply of gold. They are apparently sceptical about the ability of the Federal Reserve Banks and the Central Banks of other countries to cope with the situation:—

> "Some people believe that with the federal reserve system prices will be maintained at a high level. It may be recalled that this argument was used in 1919, and with the federal reserve system there occurred the most violent drop in prices of which we have a statistical record in America."

But this seems to imply that the Federal Reserve Board have learned nothing since 1919. As a matter of fact they have learned a great deal, as is shown (amongst other things) by the comparative steadiness of American prices during the last three years, notwithstanding the

continued inflow of gold. The future course of prices may be uncertain, but it is reasonable to hope that joint action of the Federal Reserve Board and the Bank of England may succeed in preventing the wide variations in the commodity value of gold such as occurred in the 19th century, with their attendant harmful consequence to agriculture.

Fruit Pollination in Relation to Commercial Fruit Growing.—(Cecil H. Hooper, M.R.A.C., F.L.S. Fruit Bulletin 10, 1925; South-Eastern Agric. Coll., Wye, 8 pp., price 1s.) In this bulletin, which is reprinted from the "Fruit, Flower, and Vegetable Trades Review," the pollination of both bush fruit and top fruit are dealt with. The varieties of apples, pears, plums and cherries are shown as being sterile, partially fertile or self fertile, and are further classified according to their order of flowering. Mr. Hooper believes that the bumble bees, the hive bees, and the small wild bees are the most valuable as transporters of pollen. A useful bulletin giving much information in a condensed form, which should be valuable to growers, even outside the Kent area.

A Textbook of General Botany for Colleges and Universities.—(Richard M. Holman and Wilfred W. Robbins, 570 pp. New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1924. Price £1.) In few things does the personal factor enter more strongly than in the making and in the choosing of textbooks; the present work, however, is one which will make many friends. The authors are men who hold high teaching posts in the University of California, and as an outcome of their experience have aimed at producing a work which can take the place of lecture notes and allow the teachers to devote more time to practical work, etc. There are many in this country whose sympathies are with this point of view. The book possesses two outstanding features: it is admirably illustrated and it is well supplied with summaries and contrasting paragraphs, arranged in parallel columns. Many of the illustrations are original, most of them are diagrammatic, and some are of especial interest; those which are not original possess the advantage that they are mostly new to textbooks. It is worth while drawing attention to Fig. 126, on p. 161, which is not our common Ivy (*Hedera helix*), but the common *Ampelopsis Veitchii*. There are two parts. Part I (pp. 1-316) deals with the anatomy, morphology and physiology of the Spermatophytes, using well-known agricultural, arboricultural and horticultural species as examples. Part II is mainly devoted to a short study of fungi, ferns, etc., but to these are added accounts of the life history of a gymnosperm (pine) and of a cereal (wheat), and also a chapter on evolution and heredity. While the book is designed as a class-book for the teacher who wishes to teach rather than lecture, it will also be invaluable for the student working by himself and for the student who wishes to supplement his notes. It does not include systematic botany of the higher orders—which is usually specialised for each particular branch of study—but otherwise it is eminently suitable for those taking degrees in agriculture, forestry, horticulture, medicine, etc. The authors have had a clear conception of what they consider necessary, and their arrangement will appeal very strongly to many modern teachers and students.

Year Book of the National Farmers' Union, 1925.—(National Farmers' Union, London: Price 1s.) This publi-

cation consists of fourteen sections, dealing with subjects of importance to agriculturists at the present time. It should be of much value to members, and is calculated to demonstrate to all farmers who are not yet members of any farmers' association the importance, indeed necessity, of combination, if agriculture is to hold its own with opposing interests. Section I ought to be very useful: it contains, for each county, a list of agricultural educational institutions, experimental or demonstration stations, agricultural organisers, centres to which farmers may apply for advice, and the Ministry's livestock officers. A sketch is also given of the activities of these various officers and centres in assisting farmers, and of the progress of research during 1924. A section dealing with the farmer's income tax, by Mr. Chas. H. Tolley, A.C.I.S., contains all the information required by both tenant farmers and occupying owners, who naturally do not wish to pay more than they are properly liable for. Notes on tithes and land tax are also included.

The possibilities of co-operation for farmers are discussed in a section which is of particular importance, as the National Farmers' Union has undertaken on behalf of its members to carry out certain work hitherto performed by the Agricultural Organisation Society, which has now come to an end. It is stated that the number of societies working on successful lines and giving satisfaction to their members is a proof that, given the right condition and efficient management, advantage can accrue from this form of combination. It is the wish of the Union when approached by any group of farmers desiring to co-operate for specific purposes to do its best to help them to render any scheme which is launched as proof against risk of failure, as it is possible to make any commercial scheme. In a section dealing with the sugar beet industry the successful efforts of the Union to secure contracts on improved terms for growers in 1923 and 1924 are described, and a similar account of the negotiation with regard to milk contracts for 1924-5 is contained in the account of the work of the Milk and Dairy Produce Committee. These afford a striking exemplification of the value to farmers of collective bargaining through the National Farmers' Union when they are dealing with organised manufacturers or distributors.

Other sections deal with Legislation affecting Agriculture in 1924, Labour, Prices and Supplies, Facts and Hints on Railway Transport, Government Departments, and other subjects, in addition to a complete account of the many-sided work of the Union during the year, and a large amount of information of a reference nature. A good index greatly increases the usefulness of the Year Book.

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Importation of Plants, Bulbs, etc., from the United States of America.—The Ministry desires to remind importers of plants, bulbs, etc., from the U.S.A., of the importance of arranging for consignments to be accompanied by official certificates of health in the form prescribed in the Destructive Insects and Pests Order of 1922. This Order requires that plants imported into England and Wales shall be accompanied by a certificate issued by a duly authorised official of the country of origin not more than 14 days prior to the date of shipment of the consignment to the effect that the plants, etc., have been inspected and found to be healthy and free from certain specified diseases and pests.

The certificates of inspection of nursery stock issued by certain State officials under the Farms and Markets Law of the United States cannot be accepted as complying with the requirements of the Destructive Insects and Pests Order, and consignments arriving in this country with such certificates only will be treated as uncertificated consignments, examination of which will be required to be made by one of the Ministry's Inspectors at the expense of the importer.

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Agricultural Exhibition in Belgium.—An international agricultural exhibition is to be held at Liège from 4th to 13th July, 1925, which is to be honoured by a visit from the King and Queen of Belgium.

In addition to sections covering horticulture, poultry keeping and bee keeping, there will be an important section devoted to agricultural education, a dog show, and an exhibition of agricultural machinery and implements.

The exhibition is to be organised by the Société Royale Agricole de l'Est de la Belgique, and 150,000 francs has been set aside for the construction of stands, etc., and 160,000 francs for prizes.

Endeavours will be made to obtain the admission of exhibits free of customs duty.

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Foot-and-Mouth Disease.—Two fresh centres of disease have occurred since the March issue of the *Journal* was published, disease being confirmed on 2nd March at Rudheath, Northwich, Cheshire, and on 14th March on premises near Yarmouth, Isle of Wight. The usual restrictions were applied to the surrounding area of 15 miles radius in the first case, and to the Isle of Wight in the other case.

There have been no developments of the disease in respect of the areas referred to in the March issue of the *Journal*, and in all cases the restricted areas have been either materially reduced or entirely released from restrictions.

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Leaflets issued by the Ministry. — Since the date of the list given on p. 887 of the December, 1924, issue of the *Journal*, the following leaflets have been issued:—

New:—No. 76. Wire Fencing for Grassland.
,, 91. Peppermint: Its Cultivation and Distillation.
,, 99. Loans for the Purchase of Lime.
,, 103. Young Farmers' Clubs. (Boys' and Girls' Agricultural Clubs.)
,, 104. Feeding for Winter Beef Production.

Re-written:—No. 164. Potato Leaf-Roll.
,, 242. Stripe Disease of Tomatoes.

Revised:—No. 56. Apple Canker.
,, 377. "Reversion" or "Nettlehead" of Black Currant.
,, 400. List of Publications.

Amended:—No. 81. A Substitute for Dishorning.
,, 105. Wart Disease.
,, 153. Storing of Mangolds and Turnips.

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

Brooks, F. T. (edit.).—Report of Proceedings of the Imperial Botanical Conference held at the Imperial College of Science and Technology, South Kensington, July 7-16, 1924. (405 pp.) Cambridge: University Press, 1925, 15s. [58.]

Morse, R., and *Palmer, R.*—British Weeds: Their Identification and Control. (207 pp. + viii pl.) London: Benn, 1925, 10s. 6d. [63.259.]

Seale-Hayne Agricultural College.—Pamphlet 14:—Spotted Medick (a Weed of Grass Land), by *E. W. Fenton.* (8 pp.) Newton Abbot, 1925. [63.259.]

Somerville, W.—Use of Basic Slag. Reprint from "The Times." (7 pp.) London: British Basic Slag, Ltd., 1925, gratis. [63.1672.]

Cole, G. D. H.—The Life of William Cobbett, with a chapter on "Rural Rides," by *F. E. Green.* (458 pp.) London: Collins, 1925, 18s. [92.]

Field Crops.

University of Leeds and the Yorkshire Council for Agricultural Education.—Report No. 137:—Results of Experiments with Cereals, Peas, Potatoes, Swedes, Turnips and Mangels in Yorkshire, 1924. (13 pp.) Leeds, 1925. [63.3.]

Canada Department of Agriculture.—Bull. 42 (New Series):—Experiments with Wheat at the Dominion Experimental Farm, Brandon, Manitoba. A Summary, 1889-1923. (54 pp.) Ottawa, 1924. [63.311.]

Fisher, R. A.—The Influence of Rainfall on the Yield of Wheat at Rothamsted. Philosophical Transactions of the Royal Society of London, Series B, vol. 213, pp. 89-142. London: Harrison & Sons, 1924, 5s. [63.311; 551.5.]

Minnesota Agricultural Experiment Station.—Bull. 206:—Wheat and Flax as Combination Crops. (12 pp.) St. Paul, 1924. [63.311; 63.34111.]

Minnesota Agricultural Experiment Station.—Bull. 212:—Potato Investigations at the North Central Experiment Station, 1914-1923. (58 pp.) St. Paul, 1924. [63.512.]

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NOTES FOR THE MONTH.

Co-operative Marketing of Agricultural Produce.*

THE first of a series of reports on economic subjects connected with agriculture, which the Ministry has in preparation, has just been issued. A feature of the series will be reports based on the detailed investigations now being undertaken by the Department into commodity marketing and kindred problems. It is fitting, therefore, that the first report should be a survey of the present stage of development of the co-operative marketing movement in this country, for, as stated in the report, "there is a striking dearth of that responsible and comprehensive information which is necessary to enable the present position of the movement to be appreciated and understood and to serve as a basis for future effort and enterprise."

The report contains a mass of information derived from a careful and critical analysis of the returns and balance sheets of the societies themselves and from reports furnished by the Ministry's officers. All the usual forms of co-operative marketing activity, including livestock auction marts, slaughter-houses, bacon factories, the sale and processing of milk and dairy produce and the marketing of eggs, poultry, fruit, vegetables and wool, are separately reviewed. The methods and results of a number of societies are described in detail by way of illustration, and the whole is adjusted as to perspective by an interesting historical background showing the development of the various forms of co-operative marketing in this country from the early days and the general trend of events which have affected the course of the movement as a whole during the past fifty years.

No such exhaustive survey of co-operative marketing has previously been attempted so far as this country is concerned.

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* Report on Co-operative Marketing of Agricultural Produce in England and Wales (Economic Series No. 1), obtainable from His Majesty's Stationery Office, price 1s. 6d. (1s. 8½d. post free).

(60952) P.6./R.4. 8,250. 5/25 M. & S.

Indeed, even the flood of literature relating to agricultural co-operation which is poured out in ever-increasing volume by other countries, contains nothing more intensive and informative regarding existing practice than the report just issued. It should prove of enduring value to all interested in the economic organisation of agriculture in this country, and though the progress and results which it records are, in a sense, disappointing, it may not be without interest also in those parts of the world where co-operation is the main constructive idea now being directed to the enhancement of marketing efficiency.

An important chapter of the report deals with the past efforts of societies at federation for trading purposes, and discusses the economic purpose and significance of federal action in the performance of extra-local marketing services. Another chapter of general application deals with inter-trading between the agricultural and industrial co-operative movements. A number of fundamental issues are brought together for discussion in the final chapter, and it is here that all routes converge. The importance of a careful and dispassionate analysis of the business situation before any new venture is launched, the importance of the management factor, of adequately paid management, of adequate turnover and capitalisation and the provision of reserves, of grading and standardisation, of a "safety-first" price policy, and last, but not least, the importance of membership contracts in ensuring a guaranteed supply of produce for each undertaking, are put with emphasis. The report shows conclusively that far more attention must be given to these considerations in future than has been customary in the past. Indeed, to the great majority of farmers, not excluding members of existing co-operative undertakings, co-operation is little more than a name, and it is unusual to find farmers who use their societies actively as their principal medium of business. As the report says, many farmers are, at present, merely "playing with co-operation and not committing themselves to a thorough-going experiment." It is in the light of these facts, therefore, that past failures must be viewed. It may even be held that co-operative marketing as understood and practised to-day in the Dominions and elsewhere has never been really tried out in this country. The way is, therefore, open for the future, but there appears to be no sure foundation on which to build until farmers, as a whole, more fully appreciate the purpose and significance of the principles underlying co-operative organisation and have satisfied themselves that, in the final

analysis, co-operative marketing, based on such principles, will, in fact, prove to be *better business;* only when so convinced are they likely to stand by the system in the manner and to the extent which is common in other lands, and to back it with all or an agreed proportion of the produce at their command.

* * * * * *

Conference of Agricultural Organisers at Oxford.

THROUGH the kindness of the authorities of Oxford University, of Balliol College, and of the School of Rural Economy with its Research Institutes in Agricultural Economics and Agricultural Engineering, a very representative Conference of Agricultural Organisers was held in Balliol College from 3rd to 8th April.

Part of the proceedings consisted in a joint discussion between Agricultural Organisers and Specialist Advisory Officers on their mutual relations, for which the attendance of the latter class of officers was necessary, and opportunity was taken at the same time to arrange sectional conferences of these latter officers in economics, chemistry, entomology and mycology. The various meetings were also attended by officers of the Ministry and by members of the staffs of the School of Rural Economy and the two Research Institutes, and some 150 persons in all were present during the conference. At various times the conference was attended by the Minister of Agriculture (Rt. Hon. E. F. L. Wood, M.P.), and the Parliamentary Secretary (Lord Bledisloe), Dr. L. R. Farnell (Rector of Exeter College, and Pro-Vice-Chancellor of the University), Sir Francis Floud and Sir Daniel Hall. A reception was held by the Minister on the evening of Friday, 3rd April, and a welcome was extended to the conference by the Rector of Exeter on behalf of Oxford University on Saturday, 4th April. The proceedings were formally opened by the Minister on the same day.

The principal aim of the conference was to discuss the principles of agricultural experimental work, with special reference to the question of experimental error; and papers on these subjects were read by Sir D. Hall, who dealt with the general principles of agricultural experiments; by Mr. F. L. Engledow, who explained the theory of experimental error; by Sir J. Russell, who described the technique of manurial trials; by Mr. W. H. Parker, whose subject was the technique of variety trials; and by Mr. R. G. Hatton, who spoke on the technique of fruit experiments. The meeting place afforded those present

an opportunity of familiarising themselves with the educational and research work now carried on at the University to an increasing degree; the work of the School of Rural Economy was described by Mr. C. G. T. Morison (in the absence through illness of Prof. W. Somerville), that of the Institute of Agricultural Engineering by Dr. B. J. Owen; and that of the Institute of Agricultural Economics by Mr. C. S. Orwin. Further variety was introduced into the proceedings of the conference by Prof. T. B. Wood, who dealt with recent work carried out by the Animal Nutrition Institute, Cambridge University, on the nutrition of the pig; by Mr. G. D. Amery, whose subject was early agricultural literature; and by Dr. J. A. Hanley, who addressed the conference on grassland improvement. Excursions were arranged having both an agricultural and an everyday interest, the former including visits to the Kelmscott herd of dairy shorthorns and the University Farm—where the work of the Agricultural Engineering Institute was illustrated: and the latter, visits to the Morris works and the University Press, as well as to different colleges.

In opening the conference the Minister of Agriculture (the Rt. Hon. E. F. L. Wood, M.P.), referred to the distinguished men such as Lord Ernle, Sir Daniel Hall, Mr. F. D. Acland —whom Balliol College had contributed to the agricultural world. He pointed to the increasing importance of Oxford University as a centre of agricultural education and research, possessing as it did, not only the teaching centre at the School of Rural Economy, presided over by Professor W. Somerville, but also the Research Institute in Agricultural Economics, directed by Mr. C. S. Orwin, and that in the Agricultural Engineering, directed by Dr. B. J. Owen. He thought it was true to say that the economics of agriculture which had hitherto been the Cinderella of agricultural investigation were at last attaining to their rightful place in research, advisory and educational schemes. He hoped the conference would become a periodic event and an integral part of the organisation of educational and advisory work. Research, advisory and educational work in agriculture was very fortunate in one respect—it enjoyed the support of all political parties. It was noticeable that whenever agriculture had been subject to review —as had very frequently been the case in recent times—the importance of education and research had always formed one of the principal recommendations made. That was a great source of strength.

It was sometimes asked why the Ministry did not make County Authorities move more quickly in agricultural education. Those who put this question forgot that while the Ministry had a great share in the organisation by providing the sinews of finance, the work depended for its success on an effective spirit of partnership between the Ministry and the County Councils; and if the principle of local autonomy were superseded the ultimate interests of agricultural education would not be promoted.

It was, further, not always realised how very new the research and educational system was. It was really only a six years' old child, since although the outlines of the system and, in some cases, rather more than outlines, existed previous to 1914, nevertheless organisation as we now see it was in the main the work of the post-war period. In the last completed year previous to the war, the total amount spent by the Ministry on the maintenance of agricultural research was £32,000: this had now risen to £260,000, and the total expenditure by the State on agricultural education and research in the present financial year was estimated at approximately £650,000. This figure was not quoted on the theory that efficiency and improvement were synonymous with expenditure; on the other hand, it could not always be compared favourably with the expenditure of other countries in this direction. But it did show that since the war the Government had given much assistance to the development of agricultural education and research; and considerable progress had been made.

The whole of this system rested on the county agricultural organiser as the foundation. He had first of all the function of teaching the sons and daughters of agriculturists, and next, what was perhaps more difficult, that of advising and educating the adult farmers on methods of improving their farming practice. He (the Minister) had always felt that there was something of a gap between the research and scientific work that was going on and the ordinary working farmer. In considering methods of bridging this gap, he thought that not much could be learnt by reading; more could be learnt by hearing; and nearly everybody could learn by seeing. The practice of sending the farmer leaflets and literature was good in its way, but was not so effective as arranging lectures or discussion societies; and the best practice was that of demonstrations. He was quite sure that much would be achieved by this last method.

The Minister concluded by expressing the hope that as a result of the bringing together in such conferences of a great variety of thought, ideas and experience, agricultural organisers, advisory officers, research workers and others would be led to feel that they were partners working together in a common business to which all would be enabled to make a contribution of increasing value.

The conference was an undoubted success; among the many results it is only possible to refer here to two. In the first place it was made abundantly clear that yield figures obtained from trials in which no provision was made for adequate replication of plots could not be expected to give a fully reliable measure of the value of any given treatment, owing to the extent of the experimental error involved; that such trials were nevertheless of value for demonstrational purposes when the known value of the treatment was so great as to be many times larger than the experimental error, or when the object of the work was to bring out points other than yield—*e.g.*, difference in plant characteristics: that for reliable results to be obtained from field experiments replication and "careful randomisation" of plots is necessary; and that results cannot be regarded as significant unless the differences in yield of plots under treatment from control plots are at least three times the probable error.

In the second place the value of the conference in bringing together the general practitioners of agriculture—the agricultural organisers—and the specialists—the advisory officers, was amply demonstrated. Each class of officer was assisted to realise the kind of problem to be solved, and work to be carried out, by the other class of officer; to realise also the fact that for the complete success of the scheme of advisory work among farmers the closest and most cordial relations between the two classes of officers are necessary. The conference seemed to show that there was every ground for believing that in almost all cases friendly relations have already been established, which cannot but be cemented by meetings of this character.

* * * * * *

Ouse Drainage Rates.

The Ministry has now prepared a draft Order under the Land Drainage Acts, which, if confirmed, will provide for the temporary suspension of most of the rating in what are known as the upland areas of the Ouse Drainage District. It will not, however, provide for the exemption of these areas from rates

made before the Order comes into force. The Order also makes special provision as to the carrying out of works in the upland areas during the suspensory period.

A copy of the Order can be obtained free of charge on application to the Ministry's Office at 10, Whitehall Place, London, S.W.1.

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Ouse Drainage Commission.

THE Minister of Agriculture and Fisheries (the Rt. Hon. Edward Wood, M.P.), early in April appointed:—Sir H. C. Monro, K.C.B. (*Chairman*) (late Permanent Secretary to the Local Government Board), Sir John Oakley (past President of the Surveyors' Institute), Mr. W. J. E. Binnie (M.A., M.Inst.C.E., F.G.S.), and Mr. Leopold Harvey (Solicitor, Clerk to the Welland Drainage Board and other Drainage Authorities), as Commissioners to investigate the whole problem of the drainage connected with the River Ouse, with a view to advising the Ministry on the following points:—

(i) The nature and extent of the essential works required to put the Ouse Drainage System in a proper state and the estimated cost thereof.

(ii) The degree of benefit likely to be conferred on the various areas and sub-areas, into which the Ouse Drainage District is at present divided, by the execution of such works as are reported by the Commissioners to be so required.

(iii) The ability of the several areas and sub-areas respectively to contribute to the cost of executing such works.

(iv) The amount of Government financial assistance which would be essential to secure the execution of such works.

(v) The amendments of the Ouse Drainage Order necessary or expedient for enabling the Ouse Drainage District to be drained effectually.

The Minister had also appointed Mr. H. Meadows, of the Ministry, 10, Whitehall Place, London, S.W.1, to be Secretary to the Commissioners, and all communications should be addressed to him.

* * * * * *

Agricultural Research Exhibit at Wembley.

THE British Empire Exhibition is to be opened by His Majesty the King on 9th May, and the hope may be expressed that the Exhibition will prove a great success, both financially and as illustrating in some measure what the British Empire is and does. There will be much to be seen at the Exhibition which is of interest and importance to the general public, and certainly no visitor should miss seeing the British Government Pavilion, with its displays relative to agriculture, science, trade, health, housing, transport, the army, the navy, the air service and other items.

From the farmers' point of view the most attractive corner ought certainly to be the gallery of the Ministry of Agriculture, in which will be shown a representative collection of exhibits illustrating the problems dealt with by the independent agricultural research stations now financed chiefly by Government funds. The exhibits must be regarded primarily as research exhibits, but education is represented by means of a map showing the organisation of the country's agricultural institutions.

The exhibits cover a selection of subjects which attempt to outline, very briefly it is true, the story of research work which is being conducted at research institutions in England, Scotland and Wales. In order to make the exhibits even more intelligible and useful, a guide has been prepared in which an endeavour has been made to explain some of the main problems of farming, as these are represented by the soil and its treatment, farm and garden crops, live stock, land drainage, machinery, farm pests, and so forth.

The creation of the Development Fund in 1909 enabled the Departments concerned to frame a general policy of agricultural research, map out the work to be done and allot it to specially equipped institutions. With the funds which have since become available, it would be true to say that, although there is still a wide field for labour and for private munificence, there are now few agricultural problems likely to yield to research upon which some work is not being done.

In the selection, preparation and staging of the exhibits, the Research Institutions have undertaken the lion's share of the work, and to them are due, for this and for many other services, the thanks of the Ministry and of all who are interested in British agriculture. Full acknowledgment to each institution concerned is made in the official guide to the Agricultural Exhibit of the Government Pavilion, copies of which may be obtained, price 3d., post free, from the Ministry, 10, Whitehall Place, London, S.W.1.

* * * * * *

Farm Workers' Minimum Wages.

A MEETING of the Agricultural Wages Board was held on 25th March, at Gwydyr House Annexe, Whitehall, S.W.1, the Chairman, Lord Kenyon, presiding.

The Board considered notifications from various Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and

proceeded to make the following Orders carrying out the Committees' decisions :—

Beds. and Hunts.—From 30 March (when the previous Order expired) to 31 Oct., male workers, 21 and over, 30s. 6d. for 50 hr., instead of 29s. for 48 hr. as at present. Female workers, 18 and over, increase from 5d. to 6d. per hr. Proportionate rates for younger workers and differential overtime rates, the latter in the case of adult male workers being 9d. per hr. weekdays and 11d. per hr. Sundays.

Essex.—Continuing the rates for male and female workers previously in force (which expired on 28 March) to 31 Oct. Male workers, 21 and over, 30s. for 50 hr. in summer (second Monday in Feb. to second Sunday in Nov.) and 48 hr. in winter (remainder of the year).

Hereford.—From 30 March to 30 April. Female workers, 18 and over, 4½d. per hr.; 15 and under 18, 3½d. per hr.

Norfolk.—From 30 March amending the existing Order so as to provide that the extra sum payable to workers under 18 employed as cowmen, bullock-tenders, and sheep-tenders and not in sole charge of animals be reduced to 3s. per wk., and that the clause guaranteeing payment for a week of 50 hr. in summer and 48 hr. in winter be restricted to workers employed by the week or longer period.

Sussex.—Overtime rates for all classes. Male workers, 21 and over, 9d. per hr. on weekdays and 10½d. per hr. on Sundays; female workers, 18 and over, 6½d. per hr. on weekdays and 7½d. per hr. on Sundays; lesser rates for younger workers of both sexes. The rates to operate as soon as practicable after the Sussex Agricultural Wages Committee have defined the employment to be treated as overtime employment.

Radnor and Brecon.—From 3 April (when existing rates expire) to 2 May (pending the fixation of rates for a longer period). Male workers, 21 and over, 31s. for 52 hr. in summer (1 Feb. to 31 Oct.) and 50 hr. in winter (rest of the year).

Copies of the Orders in full can be obtained on application to the Secretary of the Agricultural Wages Board.

* * * * * *

Grants for Agricultural Research.

THE Ministry is prepared to receive, not later than 15th May, applications for grants in aid of scientific investigations bearing on agriculture to be carried out in England and Wales during the academic year commencing 1st October, 1925. The conditions on which these grants are offered are set out on the prescribed form of application (A.58/TG), of which copies may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, S.W.1.

THE RELATIVE PALATABILITY OF PASTURE PLANTS.

WILLIAM DAVIES, B.Sc.,
Welsh Plant Breeding Station, Aberystwyth.

IN view of the fact that the chief grasses and clovers are grown at the Welsh Plant Breeding Station both in mixtures and in pure plots, and that the plots are grazed by sheep kept under careful control, an excellent opportunity has been afforded for studying the seasonal palatability of herbage plants. The results recorded in the present article cover observations made during the whole of 1924 and during the first three months of 1925, and apply only to the preferences shown by sheep.* Arrangements are being made, however, to lay out plots at the College Farm (Nantcellan) in order to extend the scope of the enquiry to cover both cattle and horses.

The chief aims of the investigation have been to obtain exact information on the following points:—

(1) Whether selective grazing does in fact take place.

(2) Whether preference is due to some innate specific characteristic of the plants preferred, or whether selection is definitely seasonal—the plants being rather chosen for the succulency of their growth at any particular time than for any other apparent reason.

(3) Whether all the above-ground parts of plants are equally palatable or whether some parts are relished more than others.

Methods Adopted.—Fairly exact quantitative data were obtained on one experiment in particular (E.37) which consisted of pure plots, 1/400th acre each, of various nationalities of the chief grasses and clovers. Sheep were given access to the whole series of plots (duplicated for each strain) for a spell of days together at regular intervals of from ten to twenty days according to the amount of growth made, which was of course dependent on the time of year. Very careful observations were made both during and immediately after each grazing period, and marks (on a scale 0-10) were allocated to each species having regard to both the initial preference of the sheep and the extent to which they grazed particular plots throughout each period. Quantitative data were also obtained on a similar plan in the case of other pure plot experiments. In addition, accurate notes were made from time to time on three separate seed mixture trials, and on a number of trials designed to test winter and early spring productivity of various species, while in general

* For the most part Kerry Hill and Suffolk ewes and their lambs, Welsh Mountain sheep having also been grazed on some of the plots.

palatability notes have been taken after the sheep on all the enclosures and fields to which they have had access.

Discussion of Results.—The quantitative data obtained from the pure plots (chiefly E.37) are set out in detail in the table on p. 116. These data show that the sheep have exercised considerable selection, particularly during the summer grazing period, and also that in so far as individual species are concerned selection may be either—

(1) In favour of a particular species throughout the season, *e.g.*, red clover.

(2) In favour of a particular species only at certain growth periods of that species, *e.g.*, crested dog's tail.

Before discussing a number of interesting points that have emerged with reference to the whole question of palatability, it will be convenient to deal with the species separately, having regard to the evidence from all the trials under observation.

The Clovers.—It will be obvious from the results given in the Table that the clovers when regularly grazed are much sought after throughout the whole year, and that simple mixtures containing both clovers and grasses have a higher relative palatability than have the individual grasses contributing to such mixtures when grown on pure plots. There is, in fact, evidence for thinking that the grasses in a clover mixture are grazed with less discrimination and over a longer period in such mixtures than on pure plots. Observations made on the clover plots during May indicate that the more hairy types of red clover, notably American Mammoth, do not receive the same attention as average types, while the relatively hairless Bohemian red clover was undoubtedly relished more than any other strain.*

One reason why the clovers maintain a much more uniform palatability than the grasses is probably that under more or less constant grazing they never produce very much stemmy growth, but continue all the time to develop a relative abundance of fresh and succulent leaves,† while grasses like cocksfoot and Timothy produce a considerable amount of stem during May and June, perennial rye grass for an even longer period, and tall oat grass throughout most of the summer.

* It will be realised that a plant's grazing value depends on its productivity as much and sometimes perhaps more than on its palatability. It is not the purpose of this article to deal with productivity, thus a species or strain is not necessarily recommended for general use because it has been noted as palatable. The relative palatability of different strains of a highly palatable species may not be as important as would appear at first sight. In the case of red clover, for instance, if only one strain is employed in a mixture a relatively unpalatable strain would be likely to be grazed as heavily as a relatively palatable one.

† It is true that under pasture conditions some strains of red clover in particular develop a relatively large number of small flower heads, but these are not associated with a great deal of stem. See Williams, R. D., in Bulletin Series H. No. 3, of the Welsh Plant Breeding Station, pp. 131-150.

In the case of a series of red clovers allowed to grow tall and stemmy, and which were just commencing to come into flower before the sheep were turned on the plots, it was noted that the sheep preferred the tops of the stems including the flowering buds to even the leaves, thus, when plants are nearing maturity even the leaves lose their attraction for sheep. It is interesting to find that under the conditions of relatively hard grazing obtaining in connection with the trials under discussion, white clover has maintained a high and uniform attraction for sheep —Cockayne in New Zealand having noted this species as of relatively low palatability.*

Subterranean clover deserves special mention; observations made on a number of trials have shown it to be quite as palatable as red clover during the spring and summer months, while the long runners developed by this plant, especially in the young stage, are readily eaten by sheep. It differs from the other clovers in one very important respect, for as well as being highly palatable during the winter it is capable of making very decided winter growth, while observations made during January and February show that like Italian rye grass it is capable even during this period of making new growth fairly rapidly after being grazed.

Italian Rye Grass.—During the summer period this grass takes a lower place than would have been expected. This has, however, been partly, but by no means wholly, due to the position of the plots on the main experiment, which were slightly damper than those occupied by other species, the observations as a whole showing that the slightest tendency towards stagnation immediately reacts against palatability. Italian rye grass, however, being a very rapid growing grass produces a relatively large proportion of stem even during short periods of rest at the height of the growing season—the stem leaves are palatable enough to sheep, but the stems themselves are not readily taken when other leafy herbage is available, and this would largely account for the rather low summer palatability of this species. Italian rye grass is wonderfully green in winter and maintains a measure of leafy growth throughout the winter and early spring, during which period it is unsurpassed in palatability.

On plots which had been allowed to grow to practically the flowering stage before being grazed, Italian rye grass was decidedly more palatable than perennial rye grass, cocksfoot, and most other species, but probably because on the plots in

* Cockayne, L. "The Relative Palatability for Sheep of the Various Pasture Grasses." New Zealand Journal of Agriculture, Volume XVIII, No. 6.

question it had not attained to quite the same degree of maturity as the other grasses.

Perennial Rye Grass.—Perennial rye grass, though highly palatable during the winter, is slightly less so than Italian. It maintains a fairly uniform attraction for sheep during the summer, but when allowed to approximate to maturity is largely neglected.

Cocksfoot.—This grass takes a high place judging by the average figures. It is evident, however, that cocksfoot is only highly palatable when kept fairly closely grazed. In the summer sheep have entirely neglected plots approaching the hay stage, while in winter plots ungrazed became badly burned and relatively unpalatable. Cocksfoot properly grazed is not only of very high productivity, but of very high palatability during May and June.

Tall Oat Grass.—This species has taken a somewhat higher place, on the basis of the quantitative data, than might have been expected. This has, however, been largely due to the fact that the plots were kept closely grazed, for when tall oat grass is allowed to grow well into the stemmy stage it rapidly loses its attraction for sheep, and on plots in that stage was one of the last species to receive attention.

Timothy.—The high and well maintained seasonal palatability of Timothy to sheep has been a matter of some surprise, but has been borne out by all the trials. Being a late grass, if allowed to grow on without hard grazing until June, it appears to be very decidedly more palatable than cocksfoot, perennial rye grass or tall oat grass left until a similar date.

Meadow Foxtail.—Since meadow foxtail is a predominantly leafy grass it might have been expected to have been of high average palatability, but the data show that it is not relished by sheep to an outstanding extent at any period of the year. Field notes on other trials confirm this view. It is a grass which burns badly as the season advances, and towards the late autumn and winter the notes record cases where this grass had been left untouched whilst surrounding species showed evident signs of hard grazing.

The Fescues.—It is of interest to note from the figures in the Table that the fescues, broad and fine leaved alike, are not relished by sheep to the same extent as other grasses under observation. This has been very pronounced in the case of tall fescue, which although a very leafy grass has coarse harsh leaves which have proved relatively unpalatable. The seasonal notes have shown the plots adjacent to tall fescue, as well as the

Timothy drills which have separated the plots, consistently closely grazed, while the tall fescue itself, although showing signs of much trampling, was only lightly cropped.*

It will be noted that even early in the year when keep is very short, and when tall fescue relative to most other species is making good growth, its palatability is still lower than that of most species.

The Canary Grasses (*Phalaris nodosa and P. arundinacea*).—Neither of these two species appears to be relished by sheep when other herbage is available. When fodder becomes scarcer (after the end of July) the plants are, however, by no means discarded, and during August and September appear to attain to average palatability.† Later, *P. arundinacea* becomes very winter-burned and unpalatable. *P. nodosa*, although remaining fairly winter-green and moderately productive, is none the less of low palatability in January and February.

Crested Dogstail.—It will be noted that this species has taken a comparatively high place on average figures. It is of very considerable palatability to sheep except at the period which coincides with maximum flower production (late May and early June) when a very large number of stems are developed. The stems are not touched by sheep, and it is probably this excess of stems developed at the height of the grazing season which has been chiefly responsible for the low esteem in which crested dogstail is apparently held by numerous investigators.‡ There is little doubt, however, that crested dogstail should rank as an important pasture plant on fields open to sheep throughout the year, and particularly on relatively poor land.

Rough Stalked Meadow Grass.—This grass is highly relished by sheep during the winter period—although the growth is but slight, it remains very winter-green and is heavily grazed. This

* Evidence obtained on a semi-permanent pasture in Buckinghamshire would seem to suggest that both tall and meadow fescue are less palatable to milch cows than perennial rye grass and cocksfoot, for example. A 30-acre field which had been seeded out in two portions approximately 28 years ago recently came under the writer's observation. On one portion perennial rye grass and cocksfoot were the dominant grasses, while on the other portion dominance was shown by tall and meadow fescue. During the early part of the grazing season at all events the cattle showed a decided preference for the cocksfoot-rye grass area. The cattle evidence in this case thus appears to agree in detail with the sheep data given in the Table.

† Observations made during March, 1924, on one of the experimental fields of Mr. Stanley M. Bligh, of Cilmery, Breconshire, confirm the above early season observations as to reed canary grass (*P. arundinacea*). A small area of this grass had been sown in drills on a field laid out with an ordinary mixture. The drills had made early leafy growth but had been entirely disregarded by the sheep although keep was decidedly limited at this period.

‡ See, *e.g.*, Johnstone-Wallace, D. B. "Experiments with seed mixtures in the North Riding of Yorkshire, 1921-23." Bul. No. 136 of the Univ. of Leeds and Yorkshire Council for Agricultural Education.

was particularly noteworthy during November on red clover plots in their third harvest year, in which rough stalked meadow grass had made a strong voluntary (indigenous) appearance. During the summer months, and especially at the time of active stem production, the grass is but little sought after, and this was particularly noteworthy during June.

Sweet Vernal Grass.—Observations on this grass confined to the early summer would indicate a species of very low palatability, and would further show the production of excess of flowering stems during this period. From September and onwards throughout the winter, sweet vernal grass, however, appears to be amongst the more palatable of the grasses to sheep.

Yorkshire Fog.—This grass was eaten by sheep to an appreciable extent all through the summer, but did not then compare favourably with the grasses like cocksfoot, Timothy or perennial rye grass. During the winter when keep was very scarce such plants as occurred as weeds on the plots were closely grazed. No pure plots were available for quantitative comparison with more orthodox species.

Miscellaneous Plants.—Observations were made in respect of a number of the commoner weeds of grassland, and the following notes with reference to the three most abundantly occurring weeds on the plots are of interest.

Daisies (Bellis perennis).—These herbs are not eaten to any great extent when other herbage is abundant, but during the winter months daisies appear to be extraordinarily palatable and much sought after by sheep. The leaves at this time are succulent and very winter-green and appear to be quite as, or even more, palatable than most grasses. Thus, during February probably the only grass that was as attractive to sheep as the daisy was Italian rye grass.

Rib grass (Plantago lanceolata).—Although eaten to some extent during the summer it was only in the winter that ribgrass compared favourably with the better grasses and clovers, but during this period it was not so heavily grazed as the daisies.

Buttercups (Ranunculus spp.).—The buttercups remained practically untouched even during the winter, although the leaves appeared to be succulent and were decidedly winter-green.

The Factors Influencing Palatability.—The observations as a whole have clearly indicated that palatability is influenced by a great number of variable factors, and it is desirable to consider the more important of these in some little detail.

Stage of Growth.—Speaking generally, the stage of growth of the individual plants appears to be the dominating factor affect-

ing palatability. It is the younger and more succulent growth offering on a sward that tends to receive the first and most sustained attention of sheep. Except in regard to comparatively few species, which are at all times more or less neglected, selection in the specific sense is only exercised by sheep to a marked extent during the late spring and summer period when keep is very abundant—at least this has been so in the case of the more heavily grazed swards under critical observation. At this period a number of secondary factors influence the palatability of any given species at any particular time. The following appear to be the most important.

The Relation of Leaf to Stem.—In the case of the grasses the sheep show an unmistakable preference for the leaf lamina as opposed to both leaf sheath and stem proper. The actual inflorescences of certain species of grasses in their young stages have a greater attraction for sheep than the stems bearing them, and sheep have been observed to graze the inflorescences of perennial rye grass and tall oat grass with apparent relish. In the case of pasture herbs like daisies, cat's ear and ribgrass, usually only the younger leaves are eaten, while the flowering shoots are almost entirely neglected.

Harshness to Touch.—It is probable that the chief reason for the neglect of tall fescue and to a less extent reed canary grass is the harshness of the leaves of these species, which would be at its greatest during May and June. It is probable that cocksfoot when approaching maturity is neglected for a similar reason.

Hairiness.—The relation of hairiness to the palatability of different strains of red clover has been mentioned, while extremely hairy plants like the buttercups and mouse-ear chickweed are but sparsely eaten even when keep is at its lowest during the winter. It is probable that the extreme hairiness of Yorkshire fog is the chief and perhaps the only reason for its relatively low palatability during the summer.

Habit of Growth.—The habit of growth of the grasses varies very much; the barren leaf shoots of different strains of the same species may be prostrate, erect or of intermediate habit. The two cocksfoots afford an excellent example—the indigenous plants are prostrate, the commercial more erect. Very careful notes taken after the sheep on both plots showed the erect growing commercial plants to have been more heavily grazed than the closer and more prostrate indigenous. Thus, although an excessively prostrate habit in grasses appears to be correlated with persistency, it would seem that strains possessed of such a habit are not necessarily the most desirable of pasture

plants.* It is noteworthy that although the leaves of daisies are highly succulent throughout the summer, the sheep do not appear to trouble to reach for the closely growing leaves of these rosette plants when an abundant grass leafage may presumably be taken with less effort. The effect of the habit of growth of a palatable plant in relation to that of other palatable plants was well seen in February in the case of a ley sown with Italian rye grass and extra late Montgomery red clover. At this period the clover was making practically no growth, and the green and succulent leaves present were covered by actively growing Italian rye grass, and it was the latter which was primarily taken by sheep until the sward was grazed excessively hard. The same type of phenomenon can be noted in respect of wild white clover in the summer on fields that are not over-stocked, or more strikingly still on fields which are considerably understocked. It will be noted, moreover, from the Table, that during June, July and early August the commercial mixture was more heavily grazed than the indigenous, and the observations made at the time suggest that this was primarily due to the more erect growth of the plants on the former plot, the leafage of which was, therefore, more easily accessible to the sheep.

Intensity of Grazing.—It will be obvious from the whole trend of the data presented in this paper that the intensity of the grazing must exercise a profound effect on the palatability of different species. Very heavy grazing even in May and June will afford less scope for selection than would lighter grazing during the same period. It is not therefore to be supposed that the various species would necessarily show the same scale of palatability as here recorded at another centre stocked on a different plan, where the whole conditions would be different, probably giving a somewhat different balance as between the growth stages of the several species at any given time. It must also be remembered that the extent to which a species will be sought for at any given time will in part be determined by the number and palatability of the other species to which the grazing animals have access.

The Seasonal Aspect of Palatability.—The grazing year, in so far as grass-sheep are concerned, may be divided into three main periods, namely:—early period (January-April); middle period (May-September); and late period (October-December).

Early Period.—This is the most important and difficult period of the year for the sheep breeder. Selection is shown by sheep

* The leafage of a prostrate strain of a grass growing in a mixture with erect plants tends, however, to be drawn up by the other herbage. In connection with grass breeding the relation of prostrate to erect strains with reference to both persistency and palatability affords at once an interesting and difficult problem.

at this period for those plants that remain winter-green, *e.g.*, Italian rye grass, perennial rye grass, rough stalked meadow grass and crested dogstail, and also later in the period for species which start growth earliest in the spring, *e.g.*, Italian rye grass and tall oat grass, thus emphasising the importance of the factor of succulency.

Middle Period.—This period covers the time of most abundant keep on pastures, and may be divided into three sub-periods:—Pre-flowering, flowering and post-flowering.

1. (Pre-flowering.)—The constituents of a pasture are in full flush of succulent growth at this time, and selective grazing is very keen. Some of the species of earlier growth, like tall oat grass, will have begun to produce fibrous stem shoots and will tend to be relatively neglected, while very late species like Timothy will not have started vigorous growth and will not be receiving full attention.

2. (Flowering.)—This period marks the time when stock will exercise the maximum of selection—the chief tendency, however, being to leave untouched fibrous, over-mature and stemmy elements. Trials conducted at the Station indicate that in the case of pastures grazed wholly by sheep it is a sound practice to run the mower over the fields at this period—this eliminates the stems and causes a flush of fresh and succulent growth.

3. (Post-flowering.)—The growth at this period is generally predominantly leafy, and the selection of species during grazing is less intensive than during the pre-flowering or flowering periods.

Late Period.—During October and early November plants with a good aftermath assume considerable importance, and thus Italian rye grass and tall oat grass are usually highly palatable at this period. As November advances, species that tend to burn badly, such as meadow foxtail and cocksfoot, become unpalatable and tend to be neglected.

It should be stated that pastures fairly well grazed during September and October burn less than those which are rested, and there can be little doubt that the practice of accumulating foggage for the winter is necessarily associated with a considerable amount of waste.

Plants in their seeding year cater admirably for this period, being fresh and succulent, but too heavy grazing of young leys during the first autumn and winter is, of course, not to be recommended. It is better to make special sowings of Italian rye grass, which will also afford valuable grazing during the early period.

The Relation of Palatability to Nutritive Value.—In a broad way sheep appear to be decidedly discriminating with reference to choosing nutritious herbage, in so much as they exhibit a decided partiality for the highly nutritious clovers, and in the case of grasses they show a preference for young and succulent root leaves, which, as Fagan and Jones have shown, are presumably more nutritious than older leaves or stem. It is, however, quite probable that this selection in favour of a nourishing ration is largely accidental and wholly a matter of palatability, for it has been shown that they tend to neglect meadow foxtail, a grass which appears to be of particularly high feeding value, while they exhibit an unmistakable liking for Timothy, which is by no means one of the most nutritious of grasses.

Summary and Conclusions.—1. Certain species of pasture plants of generally accepted value, notably the clovers, are undoubtedly particularly palatable to sheep more or less independent of conditions or of season; while a few species, as for example tall fescue, appear always to be relatively unpalatable.

2. The chief factors influencing palatability would seem, however, to be the relative succulency of the herbage afforded by any particular species at any particular time, and this is largely due to the stage of growth of the plants.

3. The leaf lamina, particularly of young developing leaf shoots, is far more attractive to sheep than either leaf sheath or stem proper. In the case of some grasses, *e.g.*, crested dogstail. the stems are always neglected, while in the case of others the actual inflorescences are preferred to the stems.

4. The degree of harshness or of hairiness of the leaves. and the habit of growth of the plants, are secondary factors influencing palatability.

5. When the herbage consists of a number of species of about equal palatability, it will be those species the leafage of which is most easily accessible to the sheep, that is to say, which make the more erect growth, which will be chiefly grazed.

6. There are three main grazing periods during the year. The extent to which different species winter-burn has a marked effect on their palatability during the winter and early spring. During the height of the growing season plants left long ungrazed soon become mature and unpalatable.

7. Sheep will be selective in their grazing in direct proportion to the amount of palatable herbage available. The herbage is both most abundant and most varied in the early summer, when very considerable selection is exercised.

* See Fagan, T. W., and Jones, Trevor H., "The nutritive value of grasses as shown by their chemical composition." Welsh Plant Breeding Station Bulletin, series H. No 3, p. 85.

The relative palatability of some grasses and clovers at various periods of the year, and the relative palatability for the year as a whole, are shown in the following table :—

(Marks given on a scale 0—10. 10 = most palatable at time of observation.)

Species	1924						1925		Relative Palatability (Clovers 100)
	May 13th	June 1st	July 11th	August 5th	August 26th	Sept. 19th	Jan. 19th	Feb. 17th	
Red clover	10	10	10	10	10	10	10	10	100
Alsyke clover ...	10	10	10	10	10	10	10	10	100
White clover ...	10	10	10	10	10	10	10	10	100
"Hay" mixture (commercial) * ...	10	10	10	10	10	10	10	10	100
"Pasture" mixture (indigenous) † ..	10	8	9	9	10	10	10	10	95
Timothy (indigenous)	8	5	10	10	8	8	10	9	88
Timothy (commercial)	10	9	8	9½	8	9	10	9	
Cocksfoot (indigenous)	9	8	6	8	8	9	10	9	87½
Cocksfoot (commercial)	10	8	7	10	9	10	10	9	
Perennial rye grass (indigenous) ...	10	5	8	10	8	9	10	9	86
Perennial rye grass (commercial)	10	4	8	10	8	9	10	9	
Tall oat grass (indigenous)	7	5	7	9	10	9	10	9	84
Tall oat grass (commercial)	9	5	6	9½	10	10	10	9	
Crested dogstail ...	8	2	6	9	9	10	10	9	79
Italian rye grass ...	6	8	5	5	8	7	10	10	74
Sweet vernal grass	5	3	5	8	8	10	10	9	73
Rough stalked meadow grass ...	5	2	4	6	5	7	10	9½	61
Meadow fescue ...	4	1½	3	9	3	9	10	9	61
Meadow foxtail (indigenous) ...	6	5	4	5	4	6	7	9	57½
Meadow foxtail (commercial) ...	5	5	5	7	3	6	7	8	
Phalaris nodosa ...	1	1	2	7	8	8	4	6	41
Phalaris arundinacea	2	½	2	6	8	6	4	—‡	
Red fescue (Chewings)	4	2	3	4	1	2	4	8	35
Tall fescue (indigenous)	½	1	0	2	3	2	7	7	30
Tall fescue (commercial) ...	½	0	0	3	3	3	8	8	

* *"Hay" mixture (commercial)*

	lb. per acre
Italian rye grass - - -	2
Perennial rye grass - -	6
Cockstoot - - - -	8
Timothy - - - -	4
English late flowering red clover - - - - -	4
Alsyke clover - - -	1½
Wild white clover - - -	½
Total - -	26

† *"Pasture" mixture (indigenous)*

	lb. per acre
Perennial rye grass - -	8
Crested dogstail - - -	6
Rough stalked meadow grass -	2
Montgomery red clover -	4
Wild white clover - - -	2
Total - -	26

‡ Dry stems only, on green foliage.

GRASS LAND IMPROVEMENT IN THE WEST RIDING.

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DURING the last few years attention has repeatedly been called to the need for lime in many parts of England; but the question of cost has always been recognised as a serious factor, and has undoubtedly prevented the extensive liming of, at any rate, poor hill land. In this article it is hoped to show that, in certain large tracts of the West Riding of Yorkshire, liming is an economic proposition, and that—particularly now that special facilities are offered by the Government to encourage co-operative liming—it might with great advantage become a more common operation in the district under consideration, and no doubt also in other parts of the country where similar conditions prevail.

The district to which the present remarks refer is a tract of some 1,100 square miles, with Skipton-in-Craven as its approximate centre. It is a hilly area, consisting mainly of rough pasture and moorland, intersected by the fertile valleys of the upper reaches of the Nidd, Wharfe, Aire and Ribble. Although in Skipton the average annual rainfall is 38 in., on much of the surrounding higher land it is considerably heavier.

Types of Pasture.—The two main types of geological formation are Millstone Grit and Mountain Limestone, the former lying mainly to the south-east, and the latter to the north-west. Between the tops of the hills—which on the Millstone Grit are covered with heather, and on the Limestone formation mainly with a thin and wiry carpet of fine fescues—and the rich valley soils, there lie extensive areas of unproductive rough pasture in which the first and most serious limiting factor is undoubtedly want of lime. These pastures fall naturally into two types, according to the predominant constituent of the herbage. The first is known in the district as "White Bent Land," and grows from 30 per cent. to 50 per cent. of mat grass or white bent (*Nardus stricta*), together with an admixture of sheep's fescue (*Festuca ovina*), heath bedstraw (*Galium saxatile*), field woodrush (*Luzula campestris*), and tormentil (*Potentilla tormentilla*). In the second type the dominant constituent of

the herbage is common bent (*Agrostis*, spp.), and this may conveniently be termed "*Agrostis* pasture."* With both types is associated a continuous fibrous mat of undecayed vegetable matter, which may vary in thickness from 1 in. to 3 in., and which is practically impermeable to all but the heaviest rainfall.

Botanical analyses* were made of typical examples of the improvement of such land by lime and, in two cases, by lime and slag. A summary of certain of the results obtained is given in Tables I and II. It should be understood that the botanical analyses and rental values for each case refer to different parts of the same field; the first being that of the original untreated portion, and the others the limed, or limed and slagged areas, as indicated under "Treatment."

It should be stated that the rental values, where these could be ascertained, were in some cases actual, and in others estimated either by the tenants or the owners.

Lime Requirement.—In regard to the amelioration of white bent land, draining, in some cases, must be the initial step; but it is very doubtful whether this would be an economic proposition at the present time. Of such white bent land as is dry, it may be briefly said that the application of lime is the usual mode of improvement; and it is a common belief in the district that basic slag applied to such land without a previous dressing of lime fails to evoke any response. This opinion was supported by several cases examined, where it was impossible to detect, either by the eye or by botanical analyses, any result from dressings of slag alone. In forming an estimate of the amount of lime required by the type of land under consideration, the quantity of fescue present is to some extent a guide. As the percentage of fescue in the herbage increases, that of white bent decreases; and in general it is found that less lime is required on land growing a considerable amount of fescue than on pastures where this grass is less conspicuous and white bent is more decidedly dominant. As a rule white bent land has a lime-requirement of not less than 40 cwt. of quicklime per acre, and in many cases this figure is far exceeded.

Suitable Dressings of Lime.—In former days, when good small lime was obtainable for 3s. or 4s. per ton, it was not unusual to apply as much as 10 tons per acre, and 8 tons was

* For fuller details see "Observations on the Improvement of Poor Pastures in the West Riding of Yorkshire," by J. C. and D. A. Lynn: *Annals of Applied Biology*, July, 1924.

a customary dose. With the disuse of farm kilns, and the rise in price, such heavy dressings are not likely to be used again, nor are they necessary. In this connection, however, it is interesting to note that lime has recently been produced on a Yorkshire farm at a cost of little more than 10s. per ton;* and there is no doubt that many of the farm kilns that have long been closed might with advantage again be worked. On average land growing 30-40 per cent. of white bent, 15-20 per cent. of fescue, and a conspicuous amount of heath bedstraw, field woodrush, and tormentil, 3 tons per acre of good lump lime may be regarded as an adequate dressing, if followed up when the roughness begins to break—which may be from two to four years later—with 10 cwt. of basic slag. By this method better results are obtained, and at less expense, than by applying a greater quantity of lime alone. In cases where small lime is used, 4, 5, or 6 tons per acre may be the necessary dressing equivalent to 3 tons of good lump lime, according to sample. That small lime varies considerably in composition may be gathered from the following analyses† :—

		Mountain Limestone.	
Oxide of Lime	88.51	75.52	59.59
Oxide of Manganese	1.28	1.24	trace
Oxide of Iron and Alumina ...	1.98	11.18	18.66
Insoluble material	5.64	8.18	11.45
Carbonic Acid	1.12	1.13	2.07
Moisture, etc.	1.47	2.75	8.23
Total	100.00	100.00	100.00

Cost of Liming.—In 1922, when the present investigations were carried out, good small lime was in most cases the most economical form of lime for agricultural purposes. Excellent samples were examined both at the kiln and in the process of distribution in the field, which had been on offer at 12s. 6d. per ton on rail, as compared with lump lime at 32s. and ground lime at 52s. At the present time, however, similar small lime is bringing from 16s. to 17s. 6d., lump lime 35s., and ground lime 45s.; and there is therefore little to choose on the score of economy between small and lump lime, either of these being preferable to ground lime. In cases where the cartage is heavy, however, lump lime, despite its greater price per ton, may prove cheaper than small lime on account of the smaller quantity required. To the cost of the lime that of labour and

* "Lime Burning on a Yorkshire Farm," by A. G. Ruston, B.A., D.Sc., this *Journal*, November, 1924.

† Leeds University Bulletin No. 107: "The Need for Lime on Yorkshire Soils." by Dr. J. A. Hanley.

distribution must be added; and while it is realised that these must vary considerably according to local circumstances, 10s. per ton may be taken as a fair average for the district, as rail charges over big areas are not incurred. Thus if 3 tons per acre of lump lime at 33s. per ton be applied, adding 10s. per ton for labour and distribution, the cost per acre amounts to £6 9s.; a further outlay of 30s. being required later when the land is in condition to receive slag. The total cost of the improvement thus amounts to £7 19s. Using 5 tons of small lime, in place of 3 tons of lump lime, the cost may be estimated as follows:—

	£	s.	d.			£	s.	d.
5 tons small lime at		16	0	per ton	—	4	0	0
Cartage and distribution ...		10	0	per ton	-	2	10	0
10 cwt basic slag	3	0	0	per ton		1	10	0
				Total	=	8	0	0 per acre.

Thus, under ordinary circumstances, it appears to be immaterial which of these two forms is used at the present time.

Results on White Bent Pasture.—Rough white bent land responds but slowly to treatment, and the effect of the lime is sometimes not striking for three or four years. Frequently, however, close scrutiny will reveal some improvement in the second year, as evidenced by the breaking up of the mat, the greener appearance of the herbage, the decreasing prominence of white bent, heath bedstraw, and tormentil, and the presence of small clover plants here and there. On the other hand, such treatment on sound land, particularly if of the heavier type, will, when helped by judicious and skilful mixed stocking, maintain a state of fertility for as long as forty years. Occasional further and lighter dressings of basic slag will effectually prevent any deterioration from taking place.

As an example of the duration of the action of lime alone, reference may be made to Case B. Although in this instance the soil is by no means heavy the effect of lime is still very evident sixty years after its application. From information obtained, it is certain that little deterioration, if any, had taken place up to ten years ago; but latterly the soil has shown signs of becoming exhausted of lime once more, as indicated by the reappearance of such weeds as heath bedstraw, field woodrush, and sheep's sorrel (*Rumex acetosella*), the reduction of the percentage of clover and a tendency to mat-formation.

It is probable that the "lime alone" portion of Case A, Table I, is also beginning to revert. This portion was limed in 1874, and has thus remained in good condition for about fifty

TABLE I.—WHITE BENT LAND.

Case.	Altitude.	Soil and Geological Formation.	Treatment.	Botanical Analysis, 1922. Leguminosæ.	Better* Grasses.	Inferior Grasses.	Weeds and Bare Spaces.	Rental Value per Acre.
				per cent.	per cent.	per cent.	per cent.	
A.	600 ft.	Sandy loam overlying Millstone Grit. 2 in.—3 in. mat	None	Nil	16.3	63.4	18.7	5/-
			Limed 1874 (5 tons lump lime per acre)	17.5	30.0	37.7	12.0	15/-
			Limed 1874: Slagged 1922..	24.8	33.2	28.5	11.8	20/-
B.	600 ft. rising to 800 ft.	Light loam from gritty drift of Boulder Clay overlying Millstone Grit. 1½ in.—2 in. mat	None	Nil	14.0	46.2	39.8	5/-
			Limed 1862 (6 tons lump lime per acre)	5.7	36.8	37.9	18.7	?
C.	600 ft.	Gritty loam overlying Millstone Grit. 2 in.—3 in. mat	None	Nil	21.3	51.0	27.0	5/-
			Limed 1913 (5 tons small lime per acre)	31.3	41.5	16.2	9.8	25/-

TABLE II.—AGROSTIS PASTURE.

Case.	Altitude.	Soil and Geological Formation.	Treatment.	Botanical Analysis. Leguminosæ.	Better Grasses.	Inferior Grasses.	Weeds and Bare Spaces.	Rental Value per Acre
				per cent.	per cent.	per cent.	per cent.	
G.	850 ft.	Heavy loam derived from Millstone Grit shale. 1½ in. mat	None	1.4	14.3	30.4	53.5	?
			Limed 1920 (2 tons lump lime per acre)	5.6	39.2	30.7	22.5	?
			Slagged 1920 (10 cwt. 38 %)	36.0	28.6	17.7	16.1	?
H.	850 ft.	Good loam overlying Limestone. 2 in. mat	None	.1	33.4	41.1	23.4	7/6
			Limed 1908 (6¾ tons small lime per acre)	29.7	42.5	18.8	7.1	22/6

years. As will be seen from the botanical analyses, a dressing of basic slag applied to the limed area in 1922 has not only checked any tendency towards deterioration, but has effected a big improvement. It is a common experience in this district that slag applied to land which has been limed many years ago produces an excellent result.

Profit Obtained from Liming.—It may be calculated that lime followed by slag will, over a period of 45 years increase the rental value of the pasture by from 10s. to 15s. per acre, per annum, for 40 years of that period; or from 9s. to 13s. 4d. for the whole. Reckoning the cost of treatment at 160s. per acre, and the interest on this sum at 5 per cent. per annum (*i.e.*, 8s.) it will be seen that, where the improvement is calculated at 13s. 4*d.* per acre, the profit according to the enhanced rental value is 5s. 4d. per annum; and where the improvement is estimated at 9s. the profit is 1s. The actual profits occasioned by the better grazing produced and its effect upon the stock will, however, be considerably greater than these figures indicate; and there is no doubt that, although there are areas of land difficult of access, where the labour involved is too costly to permit of profitable liming, there are also extensive tracts which can, at present prices, be economically improved.

Treatment and Results with Agrostis Pasture.—The treatment of Agrostis pasture is not so straightforward as that of white bent land. There are large areas of Agrostis pasture in the West Riding which, like white bent land, need lime, and will not respond to slag without it. On the other hand, there are numerous examples of the success of slag alone on such land (see Case G, Table II), and observations in the district tend to show that on certain types of Agrostis land heavier dressings of slag would probably give a satisfactory result where the customary 10 cwt. fails. Agrostis mats differ greatly not only in depth but in their constitution; and as to some extent the lime requirement varies accordingly, the latter is no doubt some index to the mode of treatment to be pursued. Where the mat seems sufficiently open in texture, or thin enough to allow water to penetrate, the probability is that slag will be successful. There are cases of Agrostis pasture where the mat is not thick, or not very dense, and the underlying soil is suitable, when slag may with confidence be advised. There are others where the mat exceeds 2 in. in depth and is tough and

impenetrable, when it may be stated decisively that slag will produce no result. Between these extremes many instances occur in which it is impossible, without experiment, to decide whether or not basic slag will prove successful; and in all such cases a safe method is to apply an initial dressing of lime and to follow it with basic slag two or three years later. Often as little as 1-2 tons of ground burnt lime, or 2-3 tons small lime, or 2-4 tons ground limestone per acre is a sufficient dressing to open the way for slag. Lump lime, if less than two tons per acre be required, is not recommended on account of the difficulty of even spreading.

In general Agrostis pastures are more amenable to treatment than white bent land, and rather lighter dressings of lime may be used. Except on the worst types where the mat is more than 3 in. in thickness (which are not common in the district under consideration) dressings of 2-2½ tons of lump lime, or the equivalent application of small lime, with a subsequent dose of slag, will be found sufficient.

It is interesting to notice (vide Case H, Table II) that fields on the Mountain Limestone formation frequently respond to lime as well as those on other soils in this district. Wherever there is a depth of more than 6 in. of soil, even though limestone may be the underlying rock, the herbage may show all the evidence of lack of lime.

The tenant in Case H found that since the application of lime his sheep, particularly the lambs, throve much better than previously; and that whereas before the improvement the field would carry only in-calf cows, it was now able to support cows in milk during the best months of the year. In view of the fact that such an experience is by no means uncommon in the district, it is interesting to speculate as to how far the addition of lime to impoverished soil affects the lime content of the herbage, and ultimately influences animal metabolism.

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ENSILAGE.—VI: THE CHEMISTRY OF SILAGE.

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THE unfortunate history of the earliest attempts to make silage in this country lends point to the contention that the successful inclusion of ensilage in farming practice must be based on an intelligent understanding of the changes which occur during the preservation of crops by this method. It will therefore be the endeavour of the writer in this article to deal with certain chemical and nutritional aspects of the silage question in as simple a manner as possible, avoiding, as far as is practicable, the use of technical phraseology.

The Changes which occur in a Crop during Ensilage.—The changes which modify the character of a green crop during its conversion into silage are brought about by the operation of three factors :—

(1) *The Respiration of the Living Plant Cells.*—When the chaffed crop is filled into the silo, the cells of the plant material continue to live for some time, and their respiration activity leads to a portion of the carbohydrate of the crop (sugar, starch, etc.) being converted into carbon dioxide and water by combination with atmospheric oxygen. This change is accompanied by the production of heat, the latter being responsible for the familiar phenomenon known as self-heating in the mass of material. It is clear therefore that heating implies destruction of carbohydrate and the loss of important nutrient matter. The new electrical process for making silage seeks to obviate self-heating and the consequent loss of carbohydrate by causing the temperature of the chaffed fodder to be raised artificially to 50° C. (122° F.) by the passage of the electric current; at this temperature the plant cells die and respiratory activity is no longer possible.

In view of the fact that respiration is an oxidative process, it follows that the extent to which the change occurs will depend largely on the supply of air remaining in the crop after filling into the silo. Thus, if the crop is comparatively dry, it does not pack so tightly and consequently more air is retained. In such a case, a relatively high temperature may be attained in the silo. A similar result will be obtained if the process of filling the silo is carried out in stages instead of continuously. On the other hand, the ensiling of an immature sappy crop, which

settles down compactly and thereby leads to a more thorough exclusion of air, is usually associated with a low temperature rise. These considerations are of importance in view of the influence of the temperature of fermentation on the quality and type of the resulting silage.

(2) *The Activity of Plant Enzymes.*—All fresh plant materials contain substances known as enzymes, which continue to act after the death of the plant cell and which are able to bring about a breakdown of the complex constituents of the crop in much the same way as the ingredients of a foodstuff are broken down during digestion. During ensilage, for instance, the protein constituent of the crop is acted on by enzymes and to an appreciable extent is converted into the same simple materials (amino acids) as are produced when protein is digested in the animal organism. It should perhaps be pointed out that these amino acids are for the most part neutral substances and are in no way responsible for the acidity of silage. The protein of the crop may therefore be regarded as undergoing, in part, a pre-digestion in the silo, though it is questionable whether any particular advantage attaches to this change from the point of view of nutrition. It is of interest to note in passing the claim put forward on behalf of the electro-silo, namely, that it enables the protein of the crop to be preserved in an entirely unchanged condition.

(3) *The Activity of Bacteria and Fungi.*—The production of organic acids is perhaps the most characteristic feature of the changes occurring in the silo. This is partly attributed to the incomplete oxidation of carbohydrate during cell respiration in an insufficient supply of oxygen, and partly to the action of micro-organisms on the carbohydrate of the crop. The organic acids which may arise during the conversion of a crop into silage are :—

(*a*) Acetic acid (the acid of vinegar, possessing a sharp acidic smell) ;
(*b*) Propionic acid (similar in properties to acetic acid) ;
(*c*) Butyric acid (contained in rancid butter and possessing an offensive smell) ; and
(*d*) Lactic acid (the acid of sour milk, possessing little or no smell, but having a sharp acidic taste).

(*a*), (*b*) and (*c*) are usually referred to as volatile acids, whilst lactic acid is termed a non-volatile acid. With sour silage, the lactic acid is present in smaller amount than the sum of the volatile acids, the latter being mainly composed of butyric acid. In nearly all cases of unspoilt tower silage, however, lactic acid is present in excess, often very appreciable, of the volatile acids,

the latter consisting almost wholly of acetic acid. *In properly made tower silage, butyric acid should be entirely absent.* These features are brought out in Table I, which gives typical figures for the amounts of organic acids present in good maize silage.

TABLE I.—ACIDS IN MAIZE SILAGE.

	Per cent. of moist silage.
Acetic acid	0.41
Propionic acid	0.04
Butyric acid...	0.00
Lactic acid	0.89

Much work still requires to be done in regard to the elucidation of the factors which determine the course of fermentation in the silo. A promising line of investigation is suggested by the possibility of being able to bring about a desired kind of fermentation by inoculating the green fodder with preparations containing pure cultures of bacteria. Amongst a number of partially established results, one fact stands out as having been demonstrated with a fair degree of certainty, namely, that the fermentation is dominated by the lactic bacteria when the temperature in the silo rises above 50° C. (122° F.). Such a condition is unfavourable to the activity of other types of micro-organisms, and it is this consideration which explains the production of sweet silage in the stack and in the electro-silo. On the other hand, when only low temperatures are attained (as with succulent, immature forage) the course of fermentation is more uncertain, and sour silage, containing the offensive-smelling butyric acid, may result.

It cannot be too strongly emphasised, however, that the production of good silage may also be associated with low temperatures of fermentation, as is the case with two excellent types of oat and tare silage, namely, the green fruity and acid brown varieties. In the production of these types, however, due care must be exercised in ensiling the crop at the proper stage of maturity.

The foregoing account by no means exhausts the possibilities in regard to bacterial activity in the silo. It is recognised that the less resistant forms of fibre (cellulose) may be attacked and broken down by bacteria. Furthermore, where the temperature of fermentation is low, certain undesirable micro-organisms may become active and bring about changes of a putrefactive character, giving rise to ammonia and allied substances of a useless and sometimes harmful character. These changes are brought about at the expense of the valuable protein

constituents and their digestion products, and abundant evidence of such activity is obtained when sour clamp silage is submitted to analysis. In all types of unspoilt tower silage, however, the amount of ammonia is exceedingly small. Other fermentative changes may lead to the production of small amounts of fragrant-smelling substances which confer on the silage an extremely pleasant and palatable character. Such changes occur during the production of green fruity oat and tare silage.

Another interesting change, strictly chemical in character and possessing no nutritional significance, is that which concerns the chlorophyll constituent. As a consequence of the action of the organic acids arising during preservation, the green pigment is transformed into a magnesium-free pigment (phæophytin). Since the latter may exist in forms varying in colour from olive green to yellowish-brown and brownish-black, it follows that the colour of silage does not constitute a safe guide in regard to quality.

Before dismissing this phase of the subject, a word may be said on the subject of mould in silage. Spoiling by mould activity only occurs when air is permitted free access to the chaffed crop. In such a case the mass may become distinctly alkaline instead of acid and the material is thereby rendered unfit for consumption. In the tower silo, however, this type of activity only affects the surface layer, and good acidic silage is encountered at a depth of a few inches. In the making of stack silage, on the other hand, considerable wastage may occur as a result of mould action, especially if the stack be carelessly finished off.

Feeding Value of Silage.—The older literature on the subject gives the impression that silage necessarily possesses an appreciably poorer nutritive value than the green crop from which it is made. This impression still lingers in the minds of many farmers, who on that account are inclined to regard ensilage as a practice only to be adopted when it is forced on them by adverse weather conditions. Although the sour silage characteristic of the early attempts to make silage in this country undoubtedly possessed a feeding value decidedly inferior to that of the green crop, it is necessary to bear in mind that such material would nowadays be regarded as partially spoilt silage. There is every reason to believe that good tower silage is little, if at all, inferior in nutritive value to the green crop from which it has been made. Strong evidence in support of this view is afforded by the results of an investigation carried out

a year or two ago at Cambridge, when determinations were made of the digestibility of green oats and tares and also of hay and silage made from the oat and tare crop. The conditions of the experiment were so arranged as to make possible a fair comparison of the feeding values of the three types of fodder. Table II gives the results in terms of digestion coefficients. The reader should be reminded that the digestion coefficient of a given food constituent represents the number of parts of that constituent which are digested per 100 parts consumed. The silage was the green fruity type.

TABLE II.—DIGESTION COEFFICIENTS OF GREEN FODDER, HAY AND SILAGE FROM OAT AND TARE CROP.

	Green oats and tares per cent.	*Oat and tare hay* per cent.	*Oat and tare silage* per cent.
Dry matter ...	63.7	65.0	64.1
Protein ...	63.1	68.2	65.1
Crude Oil ...	51.9	36.8	73.4
Carbohydrate ...	76.5	71.3	70.5
Fibre ...	47.6	58.7	57.1

From the above data the following conclusions may be drawn :—

(1) The digestibility of the dry matter is of the same order in all three cases.

(2) There is no serious difference in the degree to which the protein of the three fodders is digested.

(3) The digestibility of the oil fraction is greatest in the case of the silage, though it must be remembered that the ether extract of silage is composed almost wholly of organic acids.

(4) The carbohydrates of the hay and silage are approximately of equal digestibility, and in both cases the digestibility is somewhat lower (but not to such an extent as was thought formerly) than that of the corresponding fraction of the green forage.

(5) The fibre constituents of the hay and silage are almost equally digested. but the fibre of the fresh green crop possesses an appreciably lower digestibility. This finding confirms the supposition that heating in the stack and in the silo leads to a definite increase in fibre digestibility. In view of the fact that such fodders contain large amounts of fibre, this increase of digestibility becomes of considerable significance.

If the productive values of the three fodders be calculated in terms of pounds of starch by the help of the digestion coefficients, it is found that the green fodder and silage possess almost equal nutritive alue, whereas the hay is slightly inferior to both. This slight superiority of silage over hay has been confirmed not only by measurements of the available energy stored up in the two feeding-stuffs. but also by the results of long-period feeding trials carried out on the University Farm at Cambridge.

Interesting results (as yet unpublished) have been obtained recently in connection with the digestibility of sweet rye grass and clover silage made in the stack. The dry matter was found to be only 47 per cent. digestible, and a notable feature of the results was the abnormally low digestion coefficient of the protein, namely, 12.2 per cent. The silage contained 4.28 per cent. of protein and it follows that the content of digestible protein was only 0.52 per cent. It was demonstrated beyond doubt that a big depression of protein digestibility occurred as a result of changes taking place in the stack silo, and a tentative explanation has been put forward which is based on a consideration of the abnormally high temperature attained in this particular stack (viz., 80° C. = 176° F.). The fall in digestibility may have been due to the exposure of the protein of the crop to this degree of heat over a protracted period and if, in the light of future work the explanation proves correct, it follows that there is a two-fold reason why the temperature of the stack should not be allowed to rise much beyond the temperature requisite for the production of sweet silage (viz., 50° C. = 122° F.). An unnecessarily high temperature implies undue destruction of carbohydrate and may further cause an appreciable depression of the digestibility of the protein constituents

Losses of Nutrient Constituents in the Silo.—From what has been said, it is clear that the ensilage of a crop must result in losses of nutrient matter (*e.g.*, carbohydrate), but that the residual silage, if unspoilt, need not possess, weight for weight of dry foodstuff, a feeding value much inferior to that of the green crop. In considering the losses which are incidental to ensilage, it must also be borne in mind that losses of a similar magnitude occur during the conversion of a green crop into hay. In Table III are shown the average results of several investigations into the changes which occur during the conversion of oats and tares into green fruity and acid brown silage.

TABLE III.—GAINS OR LOSSES IN SILAGE PRODUCTION.

	Green fruity silage. percentage gain or loss.	*Acid brown silage.* percentage gain or loss.
Dry matter	−11.2	− 7.7
Crude protein (including amides)	− 8.2	0.0
Crude oil (mainly organic acids)	+ 52.4	+ 45.0
Carbohydrate	−19.1	−14.7
Fibre	− 5.5	− 6.0
Ash (inorganic salts)	− 9.2	0.0
True protein (crude protein minus amides)	−41.0	−28.4
Amides (mainly digestion products of true protein) ...	+ 85.3	+ 96 0

The general significance of the data in Table III will be appreciated in the light of what has been written in the first section of this article. The figures bring out very clearly the essential differences between the chemical processes by which the two kinds of silage are produced. The loss of dry matter is greater in making the green fruity silage than that associated with the production of the acid brown type. This difference is largely a result of the more copious drainage which accompanies the ensilage of the less mature and more succulent crop, and further evidence of this is afforded by a study of the losses of crude protein and inorganic salts. Appreciable losses of these constituents occur in the production of green fruity silage, whilst with the acid brown variety the losses are nil. Conditions of immaturity appear to favour the splitting up of carbohydrate and true protein, and the figures for amides show that drainage away of juice must deprive the green fruity silage of substantial amounts of these soluble nitrogenous products.

The question of drainage from the silo is an urgent problem awaiting satisfactory solution. Work at Aberdeen has demonstrated that very large amounts of phosphates and lime and potash compounds may be lost as a result of juice drainage, and it follows that only by reducing the running off of juice to a minimum can the valuable inorganic constituents of the green crop be conserved. In this connection it is claimed that if a crop be ensiled in a concrete silo not provided with a drain, the expressed juice which would otherwise run off and be wasted is ultimately reabsorbed by the mass of silage. This points the way to the production of any type of silage with minimum losses, though it is not by any means certain that the retention of large volumes of acidic juice in this manner would affect the palatability of the silage beneficially. Furthermore, if the silage were used for stock at too early a date after filling, there might be a danger of the material in the lower part of the silo being very wet. The whole question of drainage from the silo is receiving attention at the present time.

The cutting of an oat and tare crop at a comparatively immature stage for the production of green fruity silage means not only bigger losses of dry matter during ensilage, but also the ensiling of a smaller weight of forage per acre than would be dealt with if the crop were cut at a maturer stage for acid brown silage. Against these considerations, however, must be set the fact that green fruity silage is distinctly superior to the acid brown type in regard to palatability, digestibility and

nutritive value, the feeding values being roughly in the ratio of 7 : 5.

As might be expected, the biggest losses of dry matter are associated with the production of sour silage. In the making of sour clamp silage from oats and tares, a 20-25 per cent. loss was measured, this figure representing the combined effects of fermentation and drainage and not taking into account actual wastage by spoiling. The smallest loss hitherto recorded in the Cambridge investigations was a 5 per cent. dry matter loss during the conversion of sunflowers into silage. The latter, however, was of a fibrous and woody nature, and on that account was little relished by stock.

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RATS.

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By far the most injurious animals in Britain are the rats, and in spite of the energetic measures taken to reduce their numbers they remain a very serious menace. They destroy enormous quantities of stored food, and spoil much more than they destroy; they do great damage to property by burrowing and gnawing; and they are vehicles of several formidable diseases. They multiply prodigiously, and there is probably one rat at least for each member of our population. They are continually being introduced afresh from foreign countries.

The Black Rat.—Neither of the rats now represented in Britain can be called a native. Both are aliens from the East, and the first to come was the Black Rat (*Rattus rattus*), whose arrival in this country dates from the time of the Crusades. In the Mediterranean region and in the East it is represented by varieties of a much lighter colour. Thus the Alexandrine variety, frequenting Asia Minor and North Africa, is brownish-grey on the back, and the Roof Rat of the Mediterranean region has the same part of its body yellowish- or reddish-brown. It seems that the black dress was acquired after the originally light-coloured *Rattus rattus* got a footing in colder countries, but it

must be kept in mind that many of the "Black Rats" (*Rattus rattus*) in Britain are actually brown, and many of the "Brown Rats" (*Rattus norvegicus*) are black. This is a source of frequent confusion, and shows that little importance can be attached to the colour until the species has been identified on other grounds, to be referred to later. For many years the black rat was a serious pest in Britain, as in Europe generally, not only because of its destructiveness but because it harboured the microbe of the plague (or Black Death). In the early eighteenth century, however, its rival the brown rat was introduced, and within fifty years this newcomer had prevailed. About the middle of the nineteenth century the black rat was a great rarity in Great Britain. In several places, *e.g.*, at Yarmouth, it has become common again, being introduced afresh by ships. Its climbing powers favour its prevalence as a ship rat, and in this respect it is more successful than its cousin.

The Brown Rat.—The original home of the Brown Rat (*Rattus norvegicus*) is in temperate Asia, and wild forms are still abundant in the region between the Caspian Sea and Tobolsk, and also to the west of Lake Baikal. It has become closely associated with man, and has been his shadow wherever he has sailed. It was not known in Western Europe till 1716, nor in Britain before 1728. The colder the country the closer is the dependence of the brown rat on man.

Darwin referred to the internecine struggle for existence between the brown rat and the black rat, which resulted in the latter becoming almost extinct in Britain. But four points must be kept in mind: (1) the brown rat is the hardier species, more of an outdoor creature and indifferent to the wetness of sewers and the like; (2) the brown rat is more of a burrower, and therefore less baulked than the black rat by barriers of stone and lime; (3) the brown rat is a much more indiscriminate eater; and (4) it is more plastic and tamable, as is well seen in the behaviour of its albino derivative the "white rat." No doubt the two species will fight when they must, but it is too simple to say that the brown rat directly killed off the black rat in the struggle for existence. As Dr. Chalmers Mitchell says: "Each species has its different aptitudes, capacities and preferences, and each insinuates itself into the most suitable environment. Possibly the extension of sewers and drains in this country has been a major cause of the greater success of the brown rat." Moreover, we cannot forget that the black rat is becoming common again in some places.

How to Distinguish Black and Brown Species.

Black Rat (*Rattus rattus*).	Brown Rat (*Rattus norvegicus*).
Smaller, of slim build, with sharp muzzle.	Larger, of heavier build, with blunt muzzle.
Ears large, naked, almost translucent, reaching or covering eyes when pressed forwards.	Ears small, hairy, thick, hardly reaching the eyes when pressed forwards.
Tail slender, at least as long as head and body.	Tail stout, never so long as head and body.
Pads on soles of. feet relatively large.	Pads on the soles relatively small.
Many slender grooved bristles in the soft fur. Usually ten teats.	Grooved bristles fewer and more slender. Usually twelve teats.
Adult weight rarely over eight ounces.	Adult weight normally 14-17 ounces.

The two species are nearly related, but they differ through and through—even in the crystals that form when their blood is dried. There are marked differences in the skulls and teeth, but to appreciate these requires some apprenticeship. For details we refer to M. A. C. Hinton's "Rats and Mice," in the British Museum Economic Series, 1918, price 1s., a very satisfactory guide. We must notice again that no reliance can be placed on differences in colour; and that differences in size and weight cannot be much utilised unless one knows that the contrasted animals are of the same age. A brown rat of thirty ounces is not uncommon, and one of 2 lb. 12 oz. has been recorded.

There should be no possibility of mixing up either of the rats with the Water Vole (*Arvicola amphibius*), badly called the "Water Rat." For the water vole is a heavily-built animal, marked by a broad head, a blunt muzzle. inconspicuous ears, and a tail with a good deal of hair. It is not infrequently found exploring in fields at a distance from the water.

Habits of Brown Rats.—Rats are most active in the darkness or semi-darkness. Their eyes can make much of dim light; and they have acute tactile sensitiveness in their whisker-hairs (or vibrissæ) and in their feet. They usually spend much of the day in their holes or burrows, resting and sleeping, and they often make comfortably lined nests. They often collect stores of food. In their coming and going in the open they make runs, which are marked by their spindle-shaped droppings. Their inclination to keep to these wonted paths makes trapping easier, but everyone knows of their suspicious wariness.

They are practically omnivorous, though vegetarian in wild conditions. The chisel-edged incisors are well adapted for gnawing, and part of the rat's activity in this direction, which

sometimes seems gratuitous, is necessary in order to keep the continuously growing incisor teeth from becoming too long. When the upper and lower teeth fail to meet properly strange overgrowths occur which sometimes end fatally. Rats may attack hard wood, lead pipes, bricks, and cement; but what they gnaw in such cases is not swallowed.

The brown rat is not such a clever climber as its cousin, but still it can do wonders. It is a better burrower than the black rat and is much more inclined to take to the water. It swims and dives well, and follows water-courses in spreading from place to place. Although it often lives among filth, it is by inclination a cleanly animal, and makes a habit of bathing whenever it gets a chance. There is often a spring movement of rats from human habitations to the open country and a return to shelter in autumn. There is often a vigorous hunting of small animals in the open and a not inconsiderable destruction of eggs and young birds. The seasonal movement is to be distinguished from " trekking from one locality to another when overcrowding becomes intolerable, or when something occurs that makes flitting desirable. There are records of a unanimous departure from a haunt where the mortality from poisoning had been great.

Rats are sociable among themselves, though there is evidently an instinct which prompts them to kill and devour the maimed or weakly. Records of their "courage" in attacking man are probably misunderstandings, for the circumstances usually point to the desperate boldness of starvation. Moreover such abnormalities of appetite as attacking the feet of elephants are apt to seem stranger than they really are, for it is very improbable that it occurs to the rat that it is gnawing at the toes of a giant mammal! There is no doubt, however, as to the resourcefulness, ingenuity, and educability of rats. They form associations readily and they can learn in a short time to scamper through the passages of a Hampton Court maze.

Family Affairs.—Brown rats may be sexually mature when three and a half or four months old, and they can breed all round the year. The sexual season for a particular female extends for about nine months, and "heat" occurs at intervals of about ten days. The male is always ready to pair. The female cannot be impregnated except at the period of "heat," which lasts for only a few hours. The period of gestation is about three weeks, and the female is ready to be impregnated within a few hours of the birth of a litter. The average number in a litter is eight, but there are often a dozen;

and there may be five or six litters in a year. The female ceases to be fertile as she grows older—a fact sometimes overlooked in estimating the rate of multiplication. She is a careful mother, but in conditions of overcrowding, inadequate food-supplies, or captivity, she may devour her offspring. The young are born blind and naked, with their ear-trumpets sealed down. Their eyes open in about a fortnight and they are weaned in the course of their fourth week. It will be understood that many of the figures, such as the number of litters in a year and the number of offspring in a litter, vary greatly according to the conditions of life.

Numbers of Rats.—Two female rats kept in captivity are known to have had in 13 months 26 litters, amounting altogether to 180 immediate offspring. But the young would begin to breed in 3½—4 months, so that the total number of descendants would be much greater. A common estimate is that a pair of rats, with six litters of eight in a year, would, with equal sexes and no deaths, be represented by 880 at the end of the first year. At this rate, there would be many hundreds of millions from a single pair and their descendants in the course of five years. Of course this never occurs.

Writing in 1918, Mr. Hinton started from the assumption that there were forty million rats in Britain at the beginning of the year, that is about one per head of the population and about one per acre of cultivated ground. He supposed that twenty millions had a chance of breeding, and that 95 per cent. of the breeding pairs died in the course of the year. He further supposed that 50 per cent. of the progeny died at birth, and that only half of the survivors had a chance of breeding, and that the young effective rats were subject to a natural mortality of 95 per cent. in the course of their first year. Even then, under suppositions so very unfavourable to the rats, the ten million pairs at the beginning of 1918 would be represented by 41,000,000 by December 31st. The cost of keeping them would be over £9,000,000, and the indirect loss entailed by their presence would be enormously greater. Mr. Hovell says that "it would not be surprising if the damage sustained by Great Britain, say in 1923, approached one million pounds sterling per week."

The Indictment of Rats.—To the farmer's interests rats are in many ways seriously hostile. They devour large quantities of grain and other foodstuffs, and foul even more. They attack root crops, and riddle stacks. They are hostile to pigs, poultry,

and pigeons. They do much damage to property, even to the extent of undermining walls. It is said that in 1909 alone £2,000,000 were spent in providing rat-catching or rat-killing apparatus.

But the indictment is still more serious when we think of rats in connection with disease. The blood of the rat often contains the microbe of the plague (*Bacillus pestis*), and this is disseminated by the rat-flea when the plague-stricken rat dies and the flea happens to pass not to another rat, as is usual, but to man. Even in these years of energetic action, the bacillus of bubonic plague occasionally occurs among black rats in British seaports.

The dangerous Trichina worm, which causes trichinosis in man, is primarily at home in the rat. When a pig eats an infected rat it becomes trichinosed, and from the pig's flesh if it is imperfectly cooked the parasite reaches man. Mr. Hinton notes that in one instance the flesh of a single pig, escaping the watchful eye of the inspector, caused 337 cases of trichinosis, and of these 101 terminated fatally.

Another horror is that the dwarf tapeworm (*Hymenolepis nana*), which is very common in man, has the rat as its preliminary host. Rats are also said to disseminate a form of infectious jaundice. Rat-bite may cause a peculiar and serious fever.

Issuing from filthy places the rat may contaminate the food of man and beast with its germ-laden droppings, and there is reason to suspect that it is the vehicle of an intestinal disease (a kind of dysentery due to an amœba) that troubles man. The circle of the rat's life cuts man's at many points, and always inimically, except that it affords a convenient animal for experimentation.

Practical Measures Against Rats.—In many cases of animals that are hostile to man's interests, epecially when they become numerous, we can find some counteractive in carnivorous mammals and birds of prey; and there is no doubt that weasels and stoats, kestrels and owls, and some other creatures levy a useful toll on rats. Everything should be done to encourage these natural checks. But the rat menace in Britain has long since passed beyond being counteracted by the balance of nature. Millions of these pests are living under the shield of artificial conditions which favour their survival and increase. Yet the serious danger is being energetically faced, and there is no doubt that man can get the better of the rat as soon as he devotes adequate energy to the problem.

The preventive measures include the protection of foodstuffs in rat-proof receptacles; the rat-proofing of houses, stables, stores and stacks; the wiring of drains; the fumigation of ships and "rat-shielding" of hawsers with large circular discs; the replacement of wood by cement, concrete and brick in infested places; and, not least important, more careful disposal of refuse and reduction of the "crumbs," big and little, on which rats so largely feed.

The destructive methods are flooding, blocking, trapping, hunting and ferreting, the use of poisoned food (*e.g.*, with barium carbonate), and fumigating the holes and burrows with poison gas (requiring careful handling).

In regard to prevention and cure, we would make four general statements: (1) success in putting an end to a dangerous and disgraceful state of affairs will be in proportion to the unanimity of action all over the country; (2) mere reduction in numbers will not give more than temporary relief, if a substantial breeding stock is allowed to remain; (3) the extermination of mice should go along with the extermination of rats; and (4) no efforts are likely to be successful unless greater care is taken with the disposal of refuse and "crumbs."

See "The Destruction of Rats," Ministry's leaflet No. 244; "Rat Destruction: some Simple Suggestions," Ministry's Form No. 264/TK; "Rats: How to Exterminate them." Miscellaneous Publications of the Ministry No. 22, 6d., post free; E. G. Boulenger, "Report on Methods of Rat Destruction" (Zoological Society of London, price 6d.). A most admirable shilling's worth is Mr. M. A. C. Hinton's "Rats and Mice, as Enemies of Mankind," published by the British Museum, 1918. "Rats, and how to Destroy them" (Mark Hovell, London, 1924, pp. 465, 10s. 6d.). Attention should also be directed to the Rats and Mice (Destruction) Act of 1919, which makes it imperative on an occupier of land to destroy rats and mice and to protect the land from infestation.

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SPRAYING EXPERIMENTS AGAINST APPLE SCAB.

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IN the following article an account is given of spraying experiments against apple scab or black spot,* which were

* The Ministry's Leaflet 131, on Apple and Pear Scab may be profitably consulted by the fruit-grower on the subject of Apple scab and its control. Full information is given on such important practical points as the most susceptible varieties as well as the best fungicides to use to control the disease.

carried out during 1923 and 1924, in a commercial plantation at Egerton, Kent.* The trees sprayed were bush trees of the variety Bismarck, planted in 1915. These comprised four rows of one block, which also contained rows of Beauty of Bath and Lane's Prince Albert, and was situated at the west side of the plantation. The trees were planted at 14 ft. square, with black currants underneath. The rest of the plantation, separated by a narrow grass path, consisted of similar trees of the varieties Bramley's Seedling, Annie Elizabeth, Beauty of Bath, Newton Wonder, Worcester Pearmain, Cox's Orange Pippin and Lane's Prince Albert. The soil was a stiffish loam. The plantation had become rather weedy during the war, and pigs had recently been brought in to root up the ground in preparation for more thorough cultivation. The four rows of Bismarck were separated from each other by alternate rows of either Beauty of Bath or Lane's Prince Albert, which protected them from accidental spray drift. All the rows of Bismarcks had suffered severely from scab in 1922. They were moderately well-grown trees which had made a fair amount of wood-growth and had cropped reasonably well during the last few years. The yearly pruning had consisted of leader-tipping from a third to a half and lateral spurring to three buds.

The actual spraying was carried out with one bamboo lance fitted with the Drake and Fletcher " Mistifier " nozzle provided with the smallest nozzle-disc, viz., number 0. The spraying machine (Weeks and Son) was provided with a lead consisting of one 60-ft. length of rubber hose piping and the power was supplied by a small 2-h.p. Emerson Brantingham petrol engine, with a 50-gallon tank, design to be drawn up and down the headland by a light tractor. The spray was applied at a pressure of from 90-100 lb.; and, at the different sprayings, from $\frac{3}{4}$ to $1\frac{1}{2}$ gallons of the spray fluid were applied to each tree. All the spraying was carried out by one person† so as to secure uniformity of treatment for each tree.

As regards spraying materials, the chemical composition of the two brands of lime-sulphur used was found to be as follows:—Brand No. I, sp. gr. 1.302, polysulphide sulphur, 18.49 per cent.; Brand No. II, sp. gr. 1.194, polysulphide sulphur, 10.16 per cent. The lead arsenate paste (Swift's) was found to contain 16.12 per cent. total arsenic oxide

* We take this opportunity of thanking Captain R. D. Scoble-Hodgins for allowing us to carry out the experiments on his trees, and for kindly providing the necessary apparatus and labour.

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FIG. 1.—Blossom trusses of Ecklinville showing the first outbreaks of scab on the earliest leaves at xx. This type of infection occurs on the variety Bismarck.

FIG. 2.—The entire crop of apples from the sprayed trees, showing result of grading the fruit.

No deduction can be made from this illustration as to any effect of the different sprays on yield, but their relative efficiency in controlling black spot may be judged by comparing the amount of fruit in Grade 3 (front row), Grade 2 (middle row) and Grade 1 (back row).

This is as follows :

	Gr. 3	Gr. 2	Gr. 1	Total
	lb.	lb.	lb.	lb.
Bordeaux - - - - - -	18	85	291	394
Lime-Sulphur and Arsenate of Lead	14	90	125	229
Lime-Sulphur - - - - -	14	81	125	220
Control - - - - - -	31	63	25	119

(As_2O_5), and 0.23 per cent. water-soluble arsenic (As_2O_5). The lime-sulphur used with the arsenate of lead paste was Brand No. II in 1923, and Brand No. I in 1924, and the manner of mixing the two constituents was as follows:—1 gallon of the concentrated lime-sulphur was mixed with 28 gallons of water, the further gallon—making 1 : 29—being used to make the lead arsenate paste—1 lb. 5 oz. (equivalent to 4 lb. lead arsenate paste to 100 gal. wash)—into a thin cream. The diluted lime-sulphur and lead arsenate were then mixed together and at once transferred to the spray tank.

The Bordeaux mixture was made on the formula:— 8 lb. copper sulphate, 8 lb. quicklime, 100 gal. water.

1923.—The first applications of the sprays were given on 23rd and 24th May,* when the trees were just out of flower. Since the trees had previously been found to be practically free from scab pustules on their young wood, it had been expected that at this date the various spray fluids could be applied to still quite healthy leaves to protect them from any subsequent infection. Such, however, was far from being the case. Inspection at this date showed that the scab fungus was already firmly established on many of the trees. The disease occurred sometimes as a few scattered spots of scab on some of the leaves, particularly those situated round the flower-spur, which are the earliest to appear in the spring. Not uncommonly, however, the leaves at the tips of the branches showed the disease, and in some cases these were so severely affected that nearly the whole upper surface of the leaf was uniformly black or sooty with the summer-spores of the fungus; in other cases the margins of the leaf had been attacked so vigorously that it was beginning to shrivel up.

The second sprayings were made on 15th June, under favourable weather conditions.

No spray injury to the foliage, of any economic importance, was observed. Some of the leaves of the trees sprayed with lime-sulphur showed an injury on the upper surface in the form of dark violet patches which were brown below; while many of the leaves (both young and full-grown) on the trees

* The lime-sulphur wash (Brand II) was applied on the morning of 23rd May, and the operation was finished at 1.30. Rain fell continuously from 2.30 onwards. It was concluded, from an examination made on 24th May, that the wash had dried on the leaves before the rain came, since these leaves were well covered with the dried spray-deposit.

sprayed with Bordeaux mixture showed the characteristic small reddish-purple spots. In no case did any shrivelling or leaf-fall result.

By 28th July a considerable number of small apples were to be found lying under the sprayed trees. The number under each tree was counted and the results tabulated. Owing to the fact that this fall of the fruit took place from some of the control trees also, and that the latter bore so little fruit, the data collected proved insufficient to allow of any inference being safely drawn as to whether the spray fluids used could

The trees used in the experiment produced but little fruit; all the apples were, however, graded. From the results shown in Table I, it is clear that all the fungicides used controlled the disease to a considerable extent. If the crop of the control trees be taken row by row, and compared with that of the trees in the same row sprayed with the various fungicides, it will be seen that the number of apples in Grade I, *i.e.*, apples entirely free from scab, is very considerably less—from 15 per cent. to 75 per cent. Comparing the relative efficiency of the fungicides used, Bordeaux mixture and lime-sulphur plus arsenate of lead applied to the trees in rows 2 and 4 controlled the scab better than did lime-sulphur, as shown by higher percentages of scab-free apples (averaging 70 per cent. for Bordeaux mixture and 77 per cent. for lime-sulphur plus arsenate of lead as against 47 per cent. and 40 per cent. for the two brands of lime-sulphur). With the trees of row 3, where the attacks of scab were less severe (the control trees giving 40 per cent. of apples in Grade I) the beneficial effects of the different fungicides used were approximately equal, the *increased* percentage of apples in Grade I, due to spraying, being as follows:— Bordeaux mixture, 24 per cent.; lime-sulphur plus arsenate of lead, 16 per cent.; lime-sulphur, Brand I, 16 per cent.; lime-sulphur. Brand II, 19 per cent. In row 1, the trees sprayed with lime-sulphur plus arsenate of lead gave 47.8 per cent. of apples in Grade I, and those sprayed with lime-sulphur, 45.2 per cent.; while the control trees gave 25 per cent.

While it was obvious that the amount of fruit graded was too small to allow of the relative efficiency of each fungicide being determined with accuracy, it seemed safe to conclude from the facts observed during the 1923 experiments that two post-blossom sprayings with any of the three fungicides, Bordeaux mixture, lime-sulphur plus arsenate of lead, and lime-sulphur, materially

increased the proportion of apples entirely free from scab (the increase varying from 15 per cent. to 75 per cent.).

1924.—The plantation was examined earlier than in 1923. On 1st May most of the leaves surrounding the trusses of flowers, which were in the advanced pink-bud stage (*see* Fig. 1), were more or less fully expanded. On several of the trees at this date the scab fungus was found on a few of the leaves surrounding the flower-spur. The fungus formed small, brownish blotches or spots (or more rarely dark lines about the midrib) on the under-surface of the leaf and usually near its tip (*see* × in Fig. 1). Most of the leaves which bore the spots of scab were situated by those flower-spurs which were nearest to the ground, but in one case the infested leaf was at a spur high up in the tree. On microscopic examination the scab spots were found to be producing thousands of summer-spores (*conidia*).

In many cases it could be seen that the leaf-tissue underlying the scab spot was brown and dead, suggesting that the infection must have taken place some days or weeks previously.

The question of the primary source or sources of infection with apple scab each season in fruit plantations may be briefly discussed here. Until 1924 the only stage known in this country in which the fungus persisted through the winter was that on the young (one-year-old) wood of certain susceptible varieties of apples. On the Bismarck trees used in the experiments, however, examination of the young wood during the winters of 1922-23 and 1923-24 showed that it was almost or quite free from scab pustules. In the same plantation, at a distance of about 75 yards, there were rows of Cox's Orange Pippin very severely affected on their young wood; and it is, of course, possible that summer-spores from the pustules on these trees may have been carried to the leaves of the Bismarck variety at the end of April, 1924, and started the disease there. A new fact, discovered in the early spring of 1924, however, indicated another very possible source of infection. The hitherto overlooked stage of the fungus was found, in which the spawn (*mycelium*) develops in the dead apple leaves during the winter and produces in the following spring fructifications containing winter spores. These spores, discharged into the air, may reach the young apple leaves and give rise there to the primary outbreaks for the season. This stage (which was well known in the other apple-growing regions of the world, but had not

previously been recorded for this country)* occurred commonly on dead scabbed leaves of the previous season in the plantation where the spraying experiments were carried out, and may well have accounted for the early appearance of scab on the trees.

The scheme of experimentation that had been planned was to supplement the two sprayings with the three fungicides used in 1923 with one additional earlier spraying, to be applied to approximately half the trees in each class, and to compare the results obtained from the two, and three, sprayings respectively. Fourteen trees were sprayed in each of the six classes, and eleven control trees were left unsprayed.

The bad weather, however, coupled with the fact that trees available for the experiments were strictly limited in number, made it impossible to carry out this programme. On 1st May, when the first application was attempted, the trees sprayed with lime-sulphur plus arsenate of lead received heavy rain before the spray fluid had dried on the leaves. The Bordeaux mixture, too, was applied under conditions which must have nullified its action, since heavy rain fell as soon as the operation was completed, and the spray on the leaves was in consequence greatly diluted, or possibly all washed off. The lime-sulphur wash, which was the first of the three spray-fluids to be applied, was the least seriously interfered with by the weather, and had probably become dry on most of the leaves before the rain came.

On 27th May, the second spraying was given to those trees which had been partially sprayed on 1st May, and on the same date the first spraying was given to the trees of the other plots. The weather was dry during the operation, with an overcast stormy sky, but occasional periods of hot sunshine.

On 9th June the sprayed trees were examined, and the incidence of scab on the leaves was recorded. The disease was described as "practically absent," if all the leaves were free, or if only one or two leaves showed a small spot of scab; as "slight," if the majority of the leaves were healthy while occasional leaves showed spots of scab; as "bad" when the

* A detailed account of this stage of the Apple Scab fungus was published in this *Journal*, vol. XXXI, Sept., 1924. It was there remarked: "Whether the formation of the winter-stage of the fungus takes place every winter in this country, or only in those winters (such as the last, 1923-4) characterised by dry, cold weather, can be determined only by future observations." It is of interest to note that, following the wet, mild winter of 1924-5, the winter-stage has again been found. Dead apple-leaves, collected in Kent and in Devonshire during February, 1925, were found to contain in abundance fructifications of apple scab with mature winter-spores ready to be discharged.

leaves on some of the branches were sooty, *i.e.*, the scab patches were so numerous that a conspicuous blackened appearance was given to the surface of the leaf; as " very bad " when sooty leaves were general. In Table II the amount of disease is shown, row by row, in all the sprayed plots, and on page 145 that on the control leaves is recorded.

Stonebridge Green Farm, Egerton; Spraying Experiments, 1923.

BISMARCK VARIETY.—Table I.

Spray fluid (applied twice)	No. of Trees in Experiment		No. of Apples picked	No. of Apples in Grade*			Percentage No. of Apples in Grade*			Weight of Apples	
	Row	No.		1	2	3	1	2	3	lb.	oz.
Bordeaux Mixture (8.8.100)	2	5	19	14	4	1	73.7	21.0	53	8	8
	3	6	11	9	5	0	64.3	35.7	—	5	4
	4	10	47	31	14	2	65.9	29.8	4.3	19	8
		21	80	54†	23	3	67.5	28.8	3.7	33	4
Lime-Sulphur, Brand II, 1 : 29 plus Arsenate of Lead Paste, 4 lb. to 100 gal. of wash	1	6	46	22	13	11	47.8	28.3	23.9	13	8
	2	5	84	66	17	1	78.6	20.2	1.2	37	3
	3	6	141	79	41	21	56.0	29.1	14 9	60	7
	4	10	153	115	30	8	75.1	19.7	5.2	73	8
		27	424	282	101	41	66.5	23.8	9.7	184	10
Lime-Sulphur, Brand I; 1 : 29	2	4	23	10	8	8	38.4	30.8	30.8	7	12
	3	3	70	39	25	6	[illegible]	35.7	8.6	26	8
	4	5	41	23	12	6	56.1	29.3	14.6	17	3
		12	137	72	45	20	52.5	32.9	14.6	51	7
Lime-Sulphur, Brand II; 1 : 29	1	6	42	19	16	7	45.2	38.1	16.7	16	5
	2	4	49	21	20	8	42.8	40.8	16.4	17	13
	3	7	51	30	19	2	58.8	37.3	3.9	20	5
	4	10	65	24	22	19	37.0	33.9	29.1	24	10
		27	207	94	77	36	45.4	37.2	17.4	79	1
Control (Unsprayed)	1	9	28	7	11	10	25.0	39.3	35 7	8	14
	3	4	20	8	9	3	40.0	45.0	15.0	8	2
	4	4	21	0	7	14	—	33.3	66.7	5	7
		17	69	15	27	27	21.8	39.1	39·1	22	7

* Grade 1 : Entirely free from scab ; Grade 2 : Scab spots few or many but apple not too seriously affected to be unmarketable ; Grade 3 : Apple so cracked or disfigured by scab as to be unmarketable.

† 7.5 per cent. of these apples showed a slight "russeting," or discoloured blotches on the skin of the apple. Such apples, while marketable, would not be fit for fancy grade purposes.

TABLE II.

Spray fluid applied	Row	No. of Trees	Amount of Disease on Leaves on 9.6.24
Bordeaux Mixture applied twice	2	2	Slight to bad
	2	3	Practically absent
	3	2	Slight to bad
	3	3	Practically absent
	4	3	Practically absent
	4	1	Bad
Bordeaux Mixture applied three times	3	3	Practically absent
	3	3	Slight to bad*
	4	8	Practically absent
Lime-Sulphur plus *Arsenate of Lead* twice	1	2	Practically absent
	1	1	Slight to bad
	2	4	Practically absent
	4	1	Practically absent
	4	1	Slight
	4	4	Slight to bad
	4	1	Bad
Lime-Sulphur plus *Arsenate of Lead* three times	1	3	Slight to bad
	3	5	Practically absent
	3	1	Slight
	4	4	Slight
	4	1	Practically absent
Lime-Sulphur twice	1	1	Slight
	1	2	Slight to bad
	2	3	Practically absent
	2	2	Slight
	4	2	Practically absent
	4	2	Slight
	4	1	Slight to bad
	4	1	Bad
Lime-Sulphur three times	1	1	Practically absent
	1	1	Slight
	1	1	Slight to bad
	3	5	Practically absent
	4	5	Slight to bad
	4	1	Bad

As the notes given in Table II indicate, spraying with all the fungicides used protected the leaves to a considerable extent from scab, which had then spread over the foliage of the unsprayed trees.

At this date it was observed that lime-sulphur did not control the disease on the leaves to the same extent as did Bordeaux mixture. On trees well sprayed with lime-sulphur it was not uncommon to find leaves where spore-producing patches of the scab fungus had spread and extended over the dried-on deposit of the spray. On the trees sprayed with Bordeaux mixture, the patches of scab were either dead or dying and no cases could be found where growth of the fungus was extending over the sprayed part of a leaf.

* One of these trees had a slight amount of scab on one side while on the other side, which was next to a control tree, the disease was bad.

A slight scorching of the tips and margins of a few leaves was noticeable on some of the trees sprayed with lime-sulphur plus arsenate of lead, as well as on some of the trees sprayed with lime-sulphur alone. On most of those sprayed with Bordeaux mixture, many of the leaves showed minute spots of a pinkish or purplish colour, due to spray injury. In none of the cases, however, was the injury severe enough to cause any economic damage, and no leaf-fall resulted.

On 24th June the last sprayings—second and third respectively—were given to the trees. The weather was hot, sunny and dry. Owing to the imperfect working of the engine, the different sprays were applied at varying pressure, particularly in the case of the Bordeaux mixture. The engine finally broke down completely, and 10 trees in the Bordeaux-sprayed plot were left unsprayed until 27th June, when the operation was completed in dry, sunny weather, using the Vermorel Knapsack Sprayer.

Table III.—Showing the percentage of "dropped" apples, 1924.

		Bordeaux mixture twice	Bordeaux mixture thrice	Lime-Sulphur Lead Arsenate twice	Lime-Sulphur Lead Arsenat thrice	Lime-Sulphur twice	Lime-Sulphur thrice	Control no spray
Row 1	Number of trees	—	—	3	3	3	3	—
	Number of dropped apples	—	—	50	387	172	636	—
	Number of apples picked	—	—	28	308	82	134	—
	Percentage dropped	—	—	64.1	55.7	67.7	82.6	—
Row 2	Number of trees	5	—	4	-	5	–	4
	Number of dropped apples	14	—	39	—	81	—	10
	Number of apples picked	90	—	47	—	96	—	85
	Percentage dropped	13.5	—	45.3	—	45.8	—	10.5
Row 3	Number of trees	5	6	—	6	—	—	4
	Number of dropped apples	135	221	—	359	—	381	188
	Number of apples picked	286	263	—	53	—	163	108
	Percentage dropped	32.1	45.7	—	87.1	—	70.0	63.5
Row 4	Number of trees	4	8	7	5	6	6	3
	Number of dropped apples	12	120	339	355	352	738	128
	Number of apples picked	115	402	13	190	14	75	178
	Percentage dropped	9.4	23.0	96.3	65.1	96.1	90.8	41.8

On 24th July the plots were examined to ascertain whether any dropping of the fruit had occurred as a result of spraying. All apples, measuring from ¾ in. diam. upwards, found on the ground under each tree, were counted.* The number is given in Table III, together with the number of apples gathered from the trees at the final picking.

With regard to *Row 2*, it will be seen that the percentage of drops under the control trees was 10.5, and was practically the same as that of the trees sprayed with Bordeaux mixture (13.5), while the percentage rose to 45 with the trees sprayed with lime-sulphur alone or with lime-sulphur plus arsenate of lead. In *Row 3* there was a drop of 63.5 per cent. from the control trees, and 32 per cent. and 45.7 per cent. from the trees sprayed with Bordeaux mixture, while the percentage rose to 70 for the trees sprayed with lime-sulphur alone and to 87 with the trees sprayed with lime-sulphur plus arsenate of lead. In *Row 4* the drop from the control trees was 41.8 per cent.; from the trees sprayed with Bordeaux mixture twice and thrice, the percentage was respectively 9.4 and 23; with lime-sulphur twice and thrice, the percentage rose to 96.1 and 90.8 respectively; and with lime-sulphur plus arsenate of lead, twice and thrice, to 96.3 and 65.1. In *Row 1* (with no control trees) lime-sulphur, twice and thrice, gave 67.7 per cent. and 82.6 per cent., respectively, and lime-sulphur plus arsenate of lead, twice and thrice, 64.1 per cent. and 55.7 per cent.

It appears safe to conclude from the above figures that while the sprayings with Bordeaux mixture did not increase the normal percentage of drops from a healthy tree, the sprayings with lime-sulphur or with lime-sulphur plus arsenate of lead did induce an abnormal drop of the fruit to a very considerable extent. The increased percentage of drops due to spraying with these two fungicides cannot be exactly determined from the evidence available, owing to the variation shown by the control trees. The point must not be lost sight of that some of the drop from control trees may have been directly or indirectly due to very severe attacks of scab on those trees,† and that possibly the drop shown by the trees sprayed with Bordeaux mixture more nearly represents the normal from a perfectly healthy tree.

* For this process, a small handrake was used wherever grass and weeds were thick enough to conceal the apples.

† The development of scab was so plentiful on the majority of the leaves of some of the trees that they looked, at a short distance, as though soot had been thrown over them. Many of the leaves showed their margins curled under the effects of the disease.

There was some evidence to indicate that the percentage of drops from individual control trees increased in proportion to the intensity of scab attack.

The crop of apples in 1924 was very unequal on the trees in the plots, and not by any means heavy. The number of apples, the weight, and the condition of the crop as regards scab (which was graded as in 1923) are shown in Table IV.

It will be seen that the percentages arrived at, when the crop is graded by weight—which is more the commercial method of valuing a crop—approximate very closely to those obtained by counting the apples. This indicates that the average weight of the individual apple in all three grades was approximately the same. Fully-grown apples occurred not only in the scab-free grade but also in Grade 3, the unmarketable condition (see Fig. 2).

In *Row 2* the unsprayed trees gave 28 per cent. of the total number of apples picked, free from scab; the trees sprayed with Bordeaux mixture gave 66 per cent., and with lime-sulphur or lime-sulphur plus arsenate of lead, 70 per cent.

In *Row 3* the control trees yielded only 11 per cent. of apples free from scab; the trees sprayed with Bordeaux mixture averaged 73 per cent., with lime-sulphur plus arsenate of lead, 94 per cent., and lime-sulphur alone 90 per cent.

In *Row 4* the control trees gave 23 per cent. free from scab; the trees sprayed with Bordeaux mixture averaged 71 per cent., with lime-sulphur plus arsenate of lead, 58 per cent., and with lime-sulphur alone, 23 per cent.*

In *Row 1* certain spray fluids were compared against each other, with the following results :—Lime-sulphur plus arsenate of lead applied twice, gave 54 per cent. of apples free from scab, applied three times, 38 per cent.; lime-sulphur alone, applied twice, gave 45 per cent.; applied three times, 39 per cent. The sprays used appeared to control the scab which, according to the grading was undoubtedly present in this row to approximately the same extent. The relative efficiency of the two sprays was thus compared, although their *actual* efficiency in this particular row cannot be estimated in the absence of unsprayed trees.

* The different results obtained with lime-sulphur in Rows 3 and 4 is probably to be attributed to the difference of intensity in the attacks of the scab in these rows. In Row 3, where 89.6 per cent. of the number of the apples were scab free, the fungus on the caves of all five trees, when examined on 9th June, was noted as "practically absent" (see Table II), while at that date the six similarly sprayed trees in Row 4, which gave only 17.3 per cent. of scab free apples, showed a severe infestation of the foliage (1 tree, "very bad," 5 trees, "slight to bad").

The main conclusion which can be drawn is, that as in 1923, all the fungicides used controlled scab to a considerable extent. Taking the averages given in Table IV, the control trees show only 21 per cent. of apples free from scab, and no less than 29 per cent. unfit for market; while with Bordeaux mixture (twice or three times applied) the averages are 74 per cent. and 73 per cent. of scab-free apples, with only 5 per cent. of apples unfit for market.

The curious fact that three sprayings with a fungicide gave in several cases less good results than with two, can only be explained by the supposition that the incidence of disease was greater on the trees sprayed three times, and that the unfavourable weather conditions prevailing when the extra (earliest) spray was applied to the trees, rendered that application ineffective.

Summary.—1. The scab fungus may occur on the leaves situated round the flower-spur of the Bismarck variety of apple before the blossoms open. In 1924 this primary infection of the leaves was well established by 1st May. It is most probable therefore that an application of a fungicide at the "pink bud" stage will be found of great value in controlling scab on Bismarck and certain other varieties.*

2. The variety Bismarck is extremely susceptible to scab on the fruit and also on the leaves, which may become sooty under the attack. The percentage number of scabbed apples on the unsprayed trees in the plots varied in 1923 from 100 per cent. to 60 per cent., and in 1924 from 89 per cent. to 72 per cent.

3. Spraying with any of the three fungicides, Bordeaux mixture, lime-sulphur and lime-sulphur plus arsenate of lead controlled scab to a marked extent.

4. None of the above spray fluids produced any serious scorching injury to the leaves or serious russeting of the fruit.

5. Some evidence was obtained which indicates that both the lime-sulphur wash and the lime-sulphur plus arsenate of lead wash may cause a dropping of the young fruit. No dropping was caused by spraying with Bordeaux mixture.

* This has been found to be the case in experiments on Bramley's Seedling carried out by the writers during 1924, the details of which will be published later.

Stonebridge Green Farm, Egerton; Spraying Experiments, 1924.

BISMARCK VARIETY.—Table IV.

Spray fluid	No. of Trees in Experiment		No. of Apples picked	No. of Apples in Grade			Percentage No. of Apples in Grade			Wt. of Apples	Weight (lb.) of Apples in Grade			Percentage Weight of Apples in Grade		
	Row	No.		1	2	3	1	2	3	lb.	1	2	3	1	2	3
Bordeaux Mixture applied twice	2	5	90	59	22	9	65.6	24.4	10.0	29	20	6	3	68.9	20.7	10.4
	3	5	286	229	51	6	80.1	17.8	2.1	84	67	15	2	79.7	17.9	2.4
	4	4	115	75	32	8	65.2	27.9	6.9	43	28	12	3	65.1	27.9	7.0
		14	491	363	105	23	73.9	21.4	4.7	156	115	33	8	73.7	21.2	5.1
Bordeaux Mixture applied thrice	3	6	263	173	79	11	65.8	30.0	4.2	93	62	27	4	66.7	29.0	4.3
	4	8	402	314	69	19	78.1	17.2	4.7	145	114	25	6	78.6	17.2	4.2
		14	665	487	148	30	73.2	22.3	4.5	238	176	52	10	73.9	21.9	4.2
Lime-Sulphur Brand I + Lead Arsenate applied twice	1	3	28	15	10	3	53.6	35.7	I 7	12	7	4	1	58.3	33.3	8.4
	2	4	47	33	13	1	70.2	27.7	2.1	19	14	5	0	73.7	26.3	—
	4	7	13	8	4	1	61.6	30.8	7.7	5	2	2	1	40.0	40.0	20.0
		14	88	56	27	5	63.6	30.7	5.7	36	23	11	2	63.9	30.5	5.6
Lime-Sulphur Brand I + Lead Arsenate applied thrice	1	3	308	116	164	28	37.7	53.2	9.1	98	39	52	7	39.8	53.1	7.1
	3	6	53	50	3	0	94.3	5.7	--	25	23	2	0	92.0	8.0	—
	4	5	190	105	72	13	55.3	37.9	6.8	70	40	25	5	57.0	35.9	7.1
		14	551	271	239	41	49.2	43.4	7.4	193	102	79	12	52.8	40.9	6.3
Lime-Sulphur Brand I applied twice	1	3	82	37	35	10	45.1	42.7	12.2	32	14	15	3	43.7	46.9	9.4
	2	5	96	67	25	4	69.8	26.0	4.2	41	28	11	2	68.3	26.8	4.9
	4	6	14	4	9	1	28.6	64.3	7.1	7	3	3	1	42.9	42.9	14.2
		14	192	108	69	15	56.3	35.9	7.8	80	45	29	6	56.2	36.3	7.5
Lime-Sulphur Brand I applied thrice	1	3	134	52	77	5	38.8	57.5	3.7	51	20	30	1	39.2	58.8	2.0
	3	5	163	146	17	0	89.6	10.4	—	63	55	8	0	87.3	12.7	—
	4	6	75	13	39	23	17.3	52.0	30.7	26	5	11	7	19.2	53.9	26.9
		14	372	211	133	28	56.7	35.8	7.5	140	80	52	8	57.1	37.2	5.7
Control	2	4	85	24	46	15	28.2	54.1	17.7	26	7	15	4	26.9	57.7	15.4
	3	4	108	12	54	42	11.1	50.0	38.9	33	5	18	10	15.1	54.6	30.3
	4	3	178	41	86	51	23.0	48.3	28.7	60	13	30	17	21.6	50.0	28.4
		11	371	77	186	108	20.8	50.1	29.1	119	25	63	31	21.0	52.9	26.1

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DIPHTHERIA IN POULTRY (ROUP OR BIRD POX).

AT the present time most investigators are agreed that avian diphtheria and bird pox are merely two forms of the same disease. It is also known under a number of other names, such as roup, diphtheria, diphtheritic roup, contagious epithelioma, chicken pox, contagious catarrh, canker, etc. It is very widespread, and is probably the commonest malady met with in adult fowls in this country.

Causal Agent.—This has been the subject of much research and has given rise to a great deal of controversy. It still remains a disputed question as to which of several particular agents described is the cause of the disease. The weight of evidence, however, points to the disease being due to a resistant filter-passing virus. Clinical evidence strongly supports the theory of a single virus, as the various forms may be observed in an infected flock at the same time.

Birds Affected.—Fowls and pigeons are particularly susceptible; it is seen frequently in turkeys, geese, ducks and guinea-fowl, and pheasants, quail and various wild birds may also be attacked. There is a great variation in individual susceptibility, young and well-bred birds being the least resistant, while some birds appear to have a natural immunity.

The immunity acquired from an attack of the disease varies in strength and duration. A severe attack produces a strong and lasting immunity, while a mild attack gives only a partial protection of short duration.

Flocks are most severely attacked during the autumn and winter months. In some outbreaks a small percentage only is affected and the death rate is low; in other cases the majority of a flock contract the disease, with a mortality up to 90 per cent. Factors which influence the mortality are the degree of exposure to infection, virulence of the virus, adverse weather conditions and insanitary houses.

Mode of Infection and Method of Spread.—Many of the conditions governing the route of infection are not fully understood. The virus is believed to gain entrance to the system either by an abrasion of the skin or by ingestion and to pass to the sites of predilection by way of the blood stream.

The disease is spread by direct or indirect contact of healthy and diseased birds. and may be carried by the hands, clothes or boots of attendants.

Symptoms.—The interval which elapses between actual infection taking place and the onset of the symptoms depends on the activity of this or that virus. It is generally from 3 to 12 days.

Three clinical forms of the disease are recognised:—

(1) Avian diphtheria, characterised by the presence of false membranes in the mouth.

(2) Bird pox, a diseased condition of the unfeathered parts of the head.

(3) A combination of the forms on the skin and mucuous membranes.

(1) *Avian Diphtheria.*—The premonitory symptoms are dullness, loss of appetite, sneezing and an occasional hard cough. These are followed by a watery nasal discharge, which gradually becomes thickened and obstructs the nasal passages. The eyes are swollen, inflamed and discharge a viscid material which sticks the eyelids together. In many cases the head is swollen, on one or both sides, below and in front of the eye, due to an accumulation of exudate within the infra-orbital sinus. This condition is known as "one-eyed roup."

Owing to the obstruction in the nasal cavity breathing occurs through the mouth, and the passage of air over the tongue causes a drying and hardening of the tip and sets up the condition popularly referred to as "pip." The catarrhal symptoms are followed by the formation of false membranes in the mouth, throat and wind-pipe.

These false membranes are of tough, greyish or yellowish exudate which adheres very firmly to the underlying tissues, considerable force being required to detach them. The removal of the exudate leaves the underlying surface inflamed and ulcerated, and a new deposit is soon formed. The false membranes spread until eventually the whole of the mouth and nostrils are involved, and even the lungs and crop may be invaded. These deposits make swallowing difficult or impossible, barely sufficient air can be inhaled to support life, diarrhœa and emaciation occur from the absorption of toxic products, and death soon follows.

In acute cases death may occur from suffocation within a couple of days of the onset of symptoms from an accumulation of exudate in the opening of the wind-pipe. The duration of the disease, however, is usually from 2 to 3 weeks. Complete recovery may take place or the disease may assume a chronic form which lasts many months. When the eyes are involved

the birds become emaciated and die from starvation owing to their inability to see the food.

(2) *Bird Pox or Contagious Epithelioma.*—This form of the disease appears as warty-looking nodules on the featherless parts of the head, such as the comb and wattles, the eyelids and adjacent skin. In severe cases the lesions may spread over the feathered parts of the head and neck, outer surface of the thighs, and the points of the wings.

The lesions first appear as flat nodules, which increase in size until they attain the dimensions of a hemp seed or even larger; they have a tendency to coalesce into cauliflower-like masses. The nodules are firm, yellow in colour, gradually turning darker with age. When the lesions are confined to the skin of the head the health of the bird does not appear to be affected, and recovery usually takes place without treatment in 10 to 12 days.

(3) *Combined Form.*—The nodules on the head are often co-existent with diphtheritic lesions in the mouth and nasal cavity, and in such cases the mortality may reach 90 per cent.

Treatment.—When an affected bird is found, it should be isolated immediately. The healthy stock should be divided into small lots and the mouth and throat inspected daily. Birds showing the slightest signs of disease should be at once removed and isolated. The houses, fittings and utensils should be disinfected regularly during an outbreak. A minimum quantity of litter should be allowed, and it should be changed frequently. The drinking water should be renewed daily. The grain should be fed in troughs, and the use of dry mash hoppers discontinued. A separate attendant should be provided for sick birds; if this is impossible they should be dealt with last. The attendant should thoroughly disinfect his hands and boots before leaving the infected premises.

When only a small number of birds are affected, individual treatment may be carried out. with strict isolation.

The discharge should be removed from the nostrils by gentle pressure, and the nasal passages syringed out with a mild antiseptic solution. Suitable antiseptic solutions are 2 per cent. permanganate of potash, 3 per cent. boracic acid, or hydrogen peroxide.

The exudate should be removed from the eyes and 2 drops of a 20 per cent. solution of argyrol instilled into them twice daily.

Diphtheria lesions in the mouth may be treated with tincture of iodine after removal of the exudate. The opening into the

wind-pipe should be examined, and if any exudate is present it should be gently removed.

When a large number of birds are affected the best method of treatment is to submerge the head in a suitable antiseptic solution for a period of 30 seconds, keeping the mouth open and the beak elevated. This should be repeated twice daily.

Swellings under the eye should be freely opened and syringed out with an antiseptic solution until the contents are removed.

Prevention.—Infection may be introduced by the purchase of birds from infected flocks or by those returned from shows or laying tests. New purchases and returned birds should be isolated for one month, and examined frequently during that period, before being allowed to join the healthy stock.

The aim of every poultry-keeper should be the prevention rather than the cure of contagious disease; therefore, when dealing with the first few cases of an outbreak the policy of destruction is one which merits serious consideration. If the value of the affected birds is not great, it is both advisable and economical to destroy them and diminish the risk of virus accumulating and the disease spreading to the whole flock. The apparently recovered bird is always a possible source of infection, as it may have developed into a carrier of the disease.

In the majority of cases the effects of a severe disease, such as avian diphtheria, are never entirely eliminated. The bird remains weakened in constitution, and is likely, sooner or later, to fall a victim to some minor ailment which a more robust bird would easily overcome. The birds should be kept under good hygienic conditions, in dry well-ventilated houses and roomy runs.

Disinfection.—The virus is very resistant, and the most thorough measures are required for its destruction.

The first and most important part in the disinfection of an infected building is the thorough cleansing of the interior by scraping and sweeping. The droppings, scrapings and litter should be burned or mixed with quicklime and removed from contact with fowls.

The walls and roosts should be scrubbed with hot water containing caustic soda (10 per cent.) to remove all dirt and grease. This also acts as a disinfectant. The house may then be washed or sprayed with a disinfectant, such as 5 per cent. solution of carbolic acid, 2 per cent. solution of compound cresol, or 2 per cent. solution of formaldehyde. The infected runs should be top-dressed with quicklime at the rate of 2 tons to the acre, and.

where practicable, ploughed up and left vacant for six months. Dead birds should be burned or buried in quicklime.

Note.—Specimens for diagnosis may be sent to the Officer in Charge, Veterinary Laboratory, Ministry of Agriculture, New Haw, Weybridge, Surrey.

In the case of poultry a whole carcass should be sent, which should not be opened before despatch.

The name and address of the owner should be set out clearly on each specimen, and an explanatory letter sent by post to the same address.

Specimens must be packed in some waterproof material and enclosed in a box: otherwise the railway authorities may refuse to accept them.

The Ministry makes a charge for post-mortem examinations; for particulars see "Veterinary Tests for Poultry Diseases," this *Journal*, April, 1925, p. 81.

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APHIDES ATTACKING VEGETABLES AND MARKET GARDEN CROPS.

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A NUMBER of kinds of plant lice or aphides may be found from time to time feeding on vegetables and market garden crops. Whilst some of these are only of occasional or local importance, other are more or less general pests and must be regarded by gardeners and market growers as of considerable importance. This especially applies to the Mealy Cabbage Aphid (*Brevicoryne brassicæ*), the Black Fly (*Aphis rumicis*) on beans and the lettuce aphides (*Amphorophora lactucæ*, etc.). The measures of control are in most cases very similar, but where any special feature is prominent, such is referred to.

The Green Pea Aphid (*Macrosiphum pisi*, Kalt.).—This large green fly or aphid is often very harmful to main crop peas and sometimes attacks broad beans and sweet peas. Clovers, lucerne and trefoils are often heavily infested. In America it is known as the Destructive Green Pea Louse. In certain seasons we find on the tops of the peas a few large green winged females, with darker head and thorax. This generally occurs in late June or July. These winged females have flown from clovers, etc., and deposit living young on the peas—small green lice which rapidly grow into green wingless females which are viviparous. These wander about and after a few days commence to produce living young. Numerous generations of wingless females and now and then winged forms continue to appear on the peas right into the autumn, when a winged brood is produced which fly off to clovers, etc., and there give rise to

oviparous (egg-laying) females, which are wingless. Later, on the peas, a brood of winged males appears, which also fly off to the clovers, etc., and fertilise the egg-laying females. The latter deposit eggs which remain on the clovers till the spring, when they hatch and the young give rise to the queen aphids which produce many young asexually (without being fertilised). These continue breeding until June when winged females appear and fly off to peas and beans. Red clover is particularly attacked by this species. These insects also live on everlasting peas (*Lathyrus*, sp.) in gardens and hedgerows and on these the sexual broods also occur. The Green Pea Aphides when mature are very timid and readily fall if the bine is shaken. The insects smother the tender tips of the peas and kill them; they also attack the flowers and even the young pods in bad attacks; the latter become curled and stunted.

Treatment.—When a bad attack is taking place on staked peas much good has been done by shaking the insects off on to tarred boards; a feather brush has been used for this purpose by growers with much benefit, but it cannot be done with the dwarf varieties. Either spraying with soft soap and quassia or dusting with nicotine powder will also soon control this pest, the tender top growths being specially aimed at. Shaking off on to the ground and trampling the plant lice in is, however, usually sufficient.

The Black Fly (*Aphis rumicis*, Fabr.).—This aphis is in many years very harmful to broad beans and it now and then, in bad " blight " years, infests runner and French beans; wax-pod beans are also attacked. Unless it is dealt with at once, complete loss of crop may be the result. This species may be found on a great variety of other plants. It is frequent on the fronds of asparagus; it infests the tips of onions and may destroy the leaves; and it is also harmful to spinach and beet: It occurs in masses on docks, poppies, etc.; in some years it invades mangolds. It also winters on *Euonymus*, both wild and cultivated. It is especially beans that are attacked, notably broad beans.

The adult wingless female is black and dull, with paler legs and antennæ with dark markings; the young are deep green and the nymphæ have many white mealy patches. The winged female appears black, but the body is really deep green with black bars; the cornicles are black and the legs have pale areas.

The winged females settle on the tops of the broad beans just when they come into flower and produce living young. These soon grow into black wingless viviparous aphides which go on

reproducing until the whole of the tops of the shoots, leaves and stalks become smothered with them. The insects secrete much honey dew, which falls on to the leaves and blossoms. They increase in certain years so rapidly that they spread downwards and get on to the young pods and ruin them. The honey dew that falls down also does harm, first specking the leaves with brown spots, and the whole plant may die. In the summer a winged brood appears on the beans, etc., and these fly to other plants. Many go to mangolds, spinach and wild plants, and later in the autumn many to the wild and cultivated Euonymus and docks. On the Euonymus and docks sexual aphides occur and the oviparous females deposit their eggs. Many also live through the winter as adults on the everlasting Euonymus in gardens. The young coming from eggs on the docks and Euonymus develop several broods there in spring and then fly off to beans, poppies. etc., and so start the summer attack.

Treatment.—As this "blight" usually appears on a few broad beans here and there, and as from these primary colonies the blight spreads to the other beans, it is advisable to pinch off and crush all the "struck" tops. There is no doubt that ants spread this insect: the ants swarm over the colonies of black fly and one can watch them carrying females away to the tops of other beans. As the winged migrants from Euonymus, docks, poppies, etc., always settle on the tender tops, it is advisable to pinch off all the tops at the same time. Some growers prefer spraying; if this is done the spray should contain 6 oz. of nicotine to 100 gal. of soft soap wash. Other growers have used quassia and soft soap and reported success.

The French Bean Root Aphid (*Geoica phaseoli*, Passerini).—This subterranean plant louse is often very common on the roots of French beans and wax-pods, and also occurs on scarlet runners and occasionally on potatoes.

The wingless female lives entirely underground on the roots, it is more or less globular in form and of a bright yellowish-buff colour to almost white, and lightly covered with meal; the antennæ are very short. In the summer a winged brood now and then occurs. The winged females appear to place their young on the soil.

Beans that have been attacked can be distinguished by the plants flagging, especially in hot weather, and by their pale sickly hue.

Treatment.—When French beans, etc., are seen to be turning prematurely yellow and wilting it is well to pull up one or two and examine the roots and soil; if aphides are present they can soon be detected. Nothing can be done at that time that would

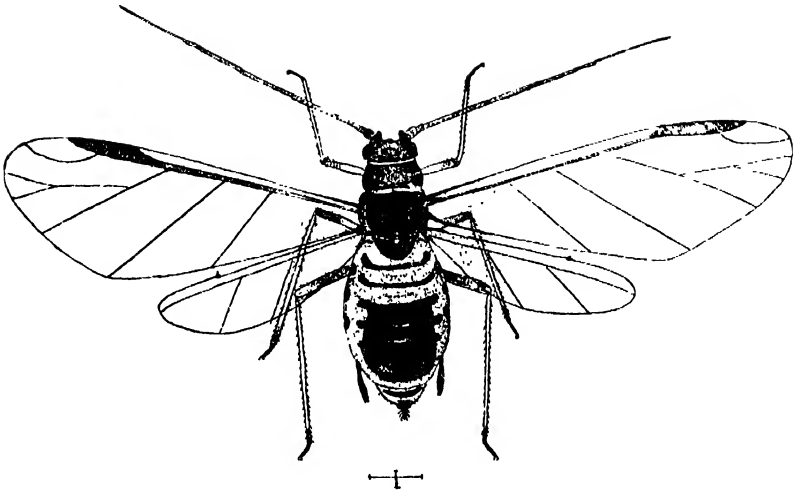

FIG. 1.—The Green Peach Aphid (Myzus persicae).
Alate viviparous female.

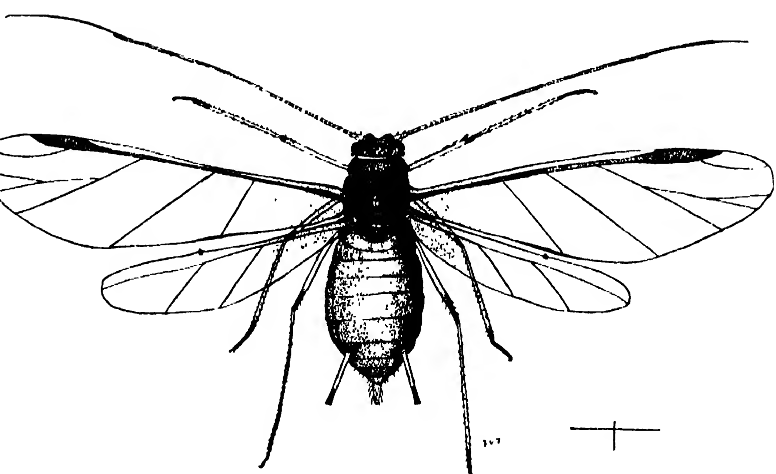

FIG. 2.—The Potato and Rose Aphid.
(Macrosiphum solanifolii).

Fig. 3. Carrot split by Anuraphis tulipae.

FIG. 1.- Anuraphis tulipae.
Apterous viviparous female.

FIG. 5.- Brevicoryne brassicae
Apterous females.

FIG. 6.—Brevicoryne brassicae
Alate females (Blakey).

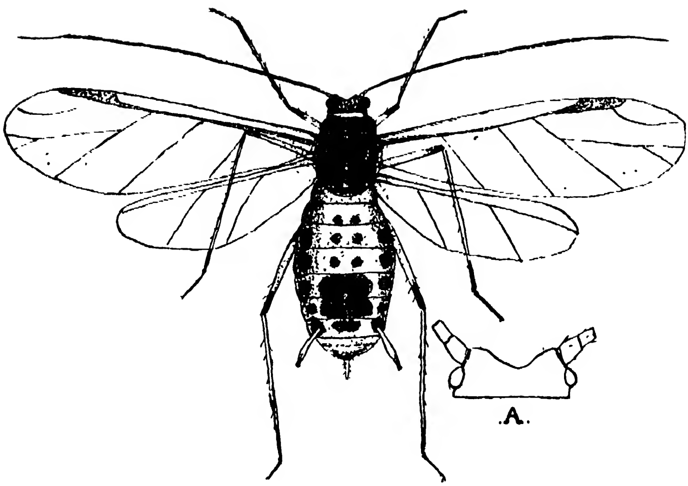

FIG. 7.—The Ribes and Lettuce Aphid. Amphorophora lactucae.
Alate female.
A. Head.

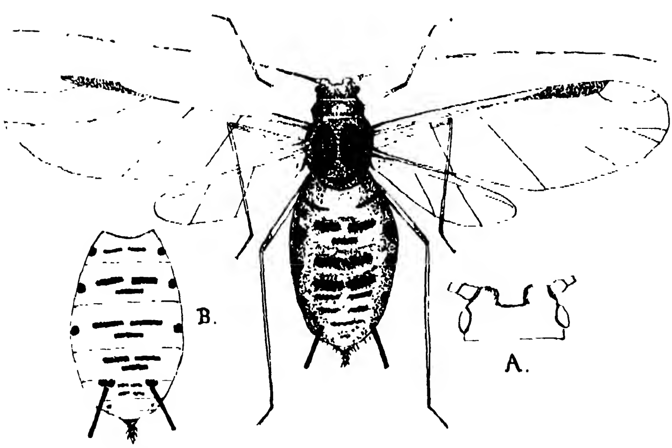

FIG. 8.—Myzus lactucae, or the Allied Ribes and Lettuce Aphid on Lettuce.
A. Head. B. On Ribes.

pay, but as soon as the beans have been gathered, the haulm should be pulled and burnt on the beds and the land dressed with naphthalene at 2 cwt. to the acre and dug in so as to prevent the winged aphides from attacking other plants.

Potato Aphides.—Four species of plant lice are found feeding on potato foliage, namely (1) the Green Potato and Rose Aphid (*Macrosiphum solanifolii*, Ashmead); (2) the Allied Potato Aphid (*Myzus pseudosolani*, Theobald); (3) the Green Peach Aphid (*Myzus persicæ*, Sulzer); and (4) the Small Potato Aphis (*Aphis solanina*, Passerini); and occasionally the Black Fly (*Aphis rumicis*, Fabricius).

The importance of these plant lice is not only that by their puncturing they damage the leaves, which in wet weather soon rot, but they carry the virus diseases of potatoes. This appears to have been proved in America and to some extent in Britain.

(1) *The Green and Pink Potato and Rose Aphid* is the largest aphid found on potatoes.

The wingless females are green or rarely pink, with long cylindrical green cornicles and long green pointed tail. The winged females are green or pink with darker head or thorax, long green cornicles, dusky at the tips, and long green tail.

The sexual forms occur on the rose and a few on potatoes, and eggs are laid there. In summer winged broods appear on roses and other plants, derived from the wingless females that hatched from the winter eggs, and fly to the potatoes and join others that have matured from the eggs laid on the potatoes at or after the time of lifting. This aphid occurs on plants under glass all the year, specially on tulips: out of doors it occurs on roses, beans, sow thistles, and many other plants. It never seems to be a serious pest on roses, but on potatoes and tulips may do much harm.

(2) *The Allied Green Potato Aphid.*

This aphid is somewhat similar in the wingless stage to (1), but the tail is shorter and the head is a different shape. It is green, yellowish-green or deep green, with rusty patches behind in some specimens; the green antennæ have dark bands and the green cornicles are cylindrical and have dusky tips. The winged female is green with dark transverse bars and lateral spots on the abdomen, dark head and thorax.

It is widely distributed over Britain and often occurs in great numbers. This insect attacks sprouting seed potatoes. When this occurs on seed stored in out-houses, etc., it flourishes and does much harm by killing the sprouts. If this seed is planted the aphides die but the seed produces a very much reduced crop. It also occurs out of doors.

(3) *The Green Peach Aphid* is a cosmopolitan insect and feeds in great numbers on potatoes. It is found on almost all plants except the conifers and broad-leaved trees.

It can at once be recognised by the fact that the cornicles of the wingless aphids are slightly swollen, and this is also generally the case in the winged forms; in the spring brood they may be cylindrical, but they are dark and not green. The wingless female is green, yellow or pale brownish-pink; cornicles the same colour as the body, dusky at the tips and slightly swollen in the middle. The winged female is green with dark head and thorax, two dark bars on the front, and a large dark patch behind, and behind that dark bars.

This insect lives almost all the year round and may be found breeding at all times under glass and indoors. It is very important as it attacks the sprouting potato seed.

(4) *The Small Potato Aphis* occurs under the leaves, but does not seem to do much harm to the plants directly.

The wingless females vary from green to dull brownish-green, but a few are almost yellow and some deep green. The much shorter antennæ and cornicles and its smaller size at once separate it from the other potato species.

Treatment.—Potato aphides may be killed by spraying with nicotine and soft soap, or quassia and soft soap, but dry spraying with nicotine seems best. It is only in bad attacks, however, that this is necessary. Seed potatoes certainly want attending to when aphides are seen on them. They are best put in closed boxes and fumigated with tobacco shreds, or if few in number may be dipped in soft soap and nicotine solution. This is very important as such attacked seed, if untreated, invariably produces poor plants and few tubers.

Aphides attacking Carrots and Parsnips.—Carrots are often attacked below ground by an aphid known as *Anuraphis tulipæ*, Boyer. The damage is done to the roots, the insects feeding on them and causing them to split. This cracking of course is often produced by excessive wet weather, but if this is the cause then the aphides are not seen.

The wingless ground form gives rise to winged females and males which come above ground at any time between September and December. The winged males appear in November and December. It also attacks bulbs of lilies, tulips, etc.

The subterranean wingless females are pale, covered with meal, and globular in form; there is much variation in colour, some being pale fawn to kid glove white, dull olive-brown, others olive-green to pale pink, with the sides and the thoracic segments often dusky. The dusky lateral marks may continue along all the segments; the last two segments are darkened; the cornicles are short and dark; the antennæ are shorter than the body. The winged female has a shiny brown to black head and thorax, with two pale bands between. The basal half

FIG. 9. Gall of Pemphigus bursarius on Poplar.

FIG. 10. —Pemphigus bursarius on Lettuce Roots.

FIG. 11.— Winged Female of Pemphigus bursarius from Lettuce.

of the abdomen is pale ochreous to fawn, dull yellow to green, some tinged with pink; the remainder is black above; there are large black spots at the sides. The cornicles are rather short, black and cylindrical; and the legs are ochreous, with dark bands.

Willow Aphides (*Cavariella capreæ*, Fbr., and *C. pastinaceæ*, Sch.) also attack carrots and parsnips. Both these are found in summer on the leaves, but especially the flower heads of carrots and parsnips, and in some years do harm to the seed crop, the insects densely clustering on the flower heads.

Both are common on willow and osier leaves in late spring and summer, and about July and on into the beginning of August they become winged, when they migrate and settle on various wild and cultivated *Umbelliferæ*, where they flourish until the autumn. At the latter period winged forms appear and fly back to the willow, where the egg-laying females deposit their eggs. The forms on the *Umbelliferæ* may give rise to a winged generation, and these pass to other *Umbelliferæ* in summer, so that the cultivated carrots and parsnips may be infected from the related wild plants as well as direct from the willows.

Treatment.—Beds where carrots or parsnips have been attacked by the root aphid should be treated with naphthalene and at once dug in so as to kill the aphides shaken off in pulling. The foliage and seed heads when attacked may be sprayed with any well-known aphicide; this is especially important as the aphids may much reduce the seed crop.

Aphides Attacking Brassicæ.—*The Mealy Cabbage Aphid* (*Brevicoryne brassicæ*, Linn.).—No more objectionable sight can be seen than winter greens badly infested with aphis. The whole plant now and then becomes a sticky mass of mealy aphides. honey dew and excreta, and to make it more repulsive still there may be found crawling about amongst them the fat leech-like larvæ of the Hover Flies, predaceous insects trying to restore the balance of nature. Such attacked plants are ruined for market. In 1904-1905 this aphid was very destructive in Kent and Essex. In the Dartford district alone hundreds of acres were attacked and thousands of pounds lost. Again in 1911 it occurred in vast swarms, causing much loss in Dorset. Cheshire, Derbyshire and again appeared in countless numbers in Essex. In 1919 it was almost epidemic until November. In 1921 and 1922 it was exceedingly destructive and contributed materially to the shortage of winter greens. All manner of *Brassicæ* are attacked, as well as swedes and turnips, charlock, shepherd's purse, sea kale, etc.

The Mealy Cabbage Aphid is noticeable in May, when a few are found here and there on cultivated and wild *Brassicæ*. By

June they are more noticeable, there appearing on the leaves small pallid blister-like areas beneath which the insects shelter; later these patches become almost white. From July onwards, if the weather is propitious for the aphides, these gradually increase and smother both the upper and under sides of the leaves and stalks, until, as stated by Buckton, "Weight for weight there is more animal than vegetable substance present." All the worst attacks have been in the autumn and winter; the summer attack even if severe dies out or does not persist in such virulent form as the autumnal. Although all cultivated *Brassicæ* are attacked perhaps Brussels sprouts suffer most of all and cauliflowers least.

The wingless viviparous female is of a rather elongated oval shape, of a dull greenish-grey hue with two series of eight black spots on each side of the back; the legs, cornicles, eyes and the tips of the antennæ are deep brown. The body is covered with a white meal which quite hides the coloration. These females produce many living young, which are shiny green, but after their first moult the mealiness appears. From August onwards appear females, which have a dark head and thorax, and a dull green abdomen, with a row of seven dark patches in the centre and a row of four black spots on each side. These may unite to form continuous dark bands. The antennæ and the rather short cornicles are dark. The egg-laying females are wingless, pale green or greenish-yellow, with a row of black spots along each side of the abdomen and a double row of five dark patches along the centre.

The sexual forms appear in autumn and onwards into the winter. Some eggs are laid on and under the leaves, but mainly on the stalks. In swedes they are noticed to be mostly on the crown. One may find the eggs, viviparous forms and sexual forms all mixed up together. The leaves in November are sometimes blackened with the eggs. The eggs hatch in April and the young lice become stem mothers, which settle under the leaf and produce living young which surround them, forming small compact colonies.

Natural Enemies.—This species is particularly preyed upon by parasitic and predaceous enemies. Hover Fly or Syrphid larvæ feed ravenously on the masses of insects. Ladybirds, both adults and larvæ, do so to some extent. Many hymenopterous parasites attack them in the autumn.*

Treatment.—All old cabbage leaves and stumps should be burnt, thus killing thousands of the eggs and over-wintering insects. All cruciferous weeds should be destroyed near the beds or fields, as many eggs are laid on them and many living aphides

* For an account of such predaceous insects see *Beneficial Insects* (with two coloured plates), price 4d., from the Ministry).

may even over-winter there and be ready to infest the Brassicæ in spring and early summer. This especially applies to charlock and shepherd's purse. The disease often starts in the seed beds and if this is seen it pays to spray the plants and so prevent the insects from being taken to the fields. The most successful spray is nicotine and soap. If spraying is not done all seedlings showing signs of aphis should be discarded and destroyed. It is doubtful if spraying in the field would pay. When waste pepper was cheap it was used, mixed with road dust, for dusting Brussels sprouts, and it might even prove possible to spray sprouts, when seen to be attacked, with strong soft soap and water, if the market price at the time would allow. The destruction as soon as possible of cabbage stumps and old leaves is a most essential matter, especially if the plants have been badly attacked. The green peach aphid also attacks Brassicæ.

Lettuce Aphides.—Four kinds of plant lice feed on lettuce and endives, and in some seasons spoil them for market, as the insects breed rapidly in the hearts, making them obnoxious, and cannot easily be cleaned out even by much washing. The four species are (1) the Ribes and Lettuce Aphid (*Amphorophora lactucæ*), (2) the Allied Ribes and Lettuce Aphid (*Myzus lactucæ*), (3) the Dark Sow-thistle Aphid (*Macrosiphum sonchi*), and (4) the Poplar Gall and Lettuce Root Aphid (*Pemphigus bursarius*). The fourth attacks the roots.

(1) *The Ribes and Lettuce Amphorophora* is the worst of these plant lice. It is a common currant and gooseberry aphid, which in some years swarms on lettuces.

The wingless female on lettuces is shiny green to yellowish-green, and the green antennæ have dark bands. The tail and cornicles are green, the latter somewhat swollen; the yellowish-green legs have dark bands. The winged female on lettuces has deep brown to black shiny head and thorax, with a yellowish-green band in front of the latter. The abdomen is yellowish-green, with an irregular dark broken area on the posterior half, two pairs of small black dots in front and three large and one small dark lateral spot and a large patch at the base of each cornicle. The tail is pale yellow. The cornicles are yellow, swollen, and dusky at the tips. The legs are yellowish-green with dark bands. The winged female on *Ribes* is very similar, but the dark abdominal area is not quite so large and there are traces on the first two to four segments of sub-median dark spots. The wingless forms are very similar also but of a somewhat deeper colour.

This insect winters on *Ribes* in the egg stage, and breeds rapidly on them in some years, doing much damage. In late May and on to July the aphides become winged and fly off to the summer food plants, some settling on lettuces, others on sow-thistles and other plants. Winged broods are produced and fly

off and attack other lettuces, etc. Mid and late crops suffer most.

(2) *The Allied Ribes and Lettuce Aphid* also infests lettuce in a similar manner to (1) and also comes from currants and gooseberries.

It can at once be distinguished from the former by the cylindrical dusky cornicles in the winged female. The wingless female is yellowish-green to light green, some pinkish, and the abdomen has dark lateral spots. The cornicles are yellowish, dusky at the tips, and cylindrical. The tail is yellow. The winged female on *Ribes* has a shiny black thorax, with a green line each side and a pale band in front; the head is green; the abdomen shiny green to yellowish-green, and there are dark basal patches, etc., on the body. The cornicles are long, thin, cylindrical, black, and paler at the tips. The wingless female is much like that on the lettuce.

Like the former species it winters on the *Ribes* and leaves them in late May and June and flics off to the lettuces, sow-thistles, etc. There the winged females produce young and reproduction goes on all the summer. In the autumn winged return migrants fly from the lettuces to the *Ribes* and there give rise to the oviparous females; having copulated with the winged males, the former lay their few eggs on the *Ribes*. In wet weather the damage done by these plant lice to lettuces, etc., is intensified and the interior of the lettuce becomes not only disfigured by the insects, but also rots.

(3) *The Dark Sow-thistle Aphid* also does some damage to the seed crop. It lives on the Annual Sow-thistle (*Sonchus oleraceæ*) and other plants.

This aphid is a rich chesnut-brown to deep shiny red; the cornicles are long and black and the tail yellow.

Control.—The only possible control of the two first species consists in destroying the aphides when on *Ribes* in winter or spring by spraying with carbolineum emulsions to destroy the ova or with nicotine soap washes to kill the hatched insects. All sow-thistles, *Crepis*, *Lapsana* and other weeds should be kept down, but when lettuces are once attacked it would not pay to adopt any curative treatment, even if such were possible, for the insects shelter in the hearts where they cannot be touched.

(4) *The Poplar Gall and Lettuce Root Aphid.*—One frequently finds on pulling lettuces, especially late ones, that the roots are covered with white flocculent wool. This is due to the above-mentioned aphid which comes from the poplar. In some seasons so many of these subterranean aphides occur that they kill the late autumn and early spring lettuces. The insect winters in two ways (*a*) on the roots of lettuce and other similar plants,

and (*b*) in the egg stage on poplars, where the stem mothers form very marked galls on the leaf stalks. One of these galls is formed by a single stem mother aphid, and in it she produces her young. The gall later bursts and the winged aphides fly away, usually in July. These winged forms place their young on the soil near lettuce and other roots. They are found in colonies in the soil, often in cavities thickly massed together, with white wool near and around, as well as on, the roots of lettuce, sow-thistle, etc. They increase rapidly on the lettuce roots and may continue to do so all the winter. At the same time winged females may arise from them in late September, October and November, and these fly off to the poplars where they produce sexual forms and eggs are laid on the buds. On the bursting of the poplar galls, the cycle is repeated. It becomes first noticeable on lettuce roots in August and gradually increases until February, when it dies down and none are noticed from May to July.

Treatment.—Obviously we cannot stop infection of the soil, as it is impossible to deal with the insect on poplar trees, but where summer lettuces have been attacked, it is just as well to destroy the insect in the soil, especially if lettuces for late winter and early spring use are to be planted there. The common practice of leaving lettuces killed by frost or rotting from wet in the soil should be avoided. As the aphid will not only live on lettuces but on sow-thistles, etc., if these occur, and any white wool is found on the roots they should be burnt and the ground dressed with naphthalene and dug in, or it should be very deeply cultivated.

The Artichoke Root Lice (*Trama troglodytes*, Heyden).—Jerusalem Artichokes are very often attacked by these pale-coloured subterranean aphides. Although they do not in the least affect the growth of the stem and leaves of such strong plants, they, nevertheless, by means of constant puncturing of the tubers, cause many of these to decay before they are lifted and many more afterwards. These aphides frequently occur in masses in artichoke beds and are always attended by ants, which take from them the sweet honey-dew they exude.

These pale fat plant lice can at once be distinguished by their long hind legs, the so-called second tarsal segment being very long, and by the curious way they lift up their hind legs if touched or frightened. The wingless females vary in colour from pale yellowish-white to pearly-white or dull yellowish-green, often semi-transparent. The antennæ are brown and less than half the length of the body. The winged female has a broad head and thorax and a small body; the antennæ are short, not much longer than the head and thorax, and the cornicles are slightly raised.

These aphides occur in the soil at all times of the year. The wingless forms feed on the roots of many other plants, including sow-thistles and thistles, etc., and are frequently found with ants in their nests.

Treatment.—After artichokes have been lifted the beds should be dressed with some soil insecticide, as the insects go on multiplying in the ground.

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FRUIT PACKING AND MARKETING IN CALIFORNIA.

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THE State of California, being on the western seaboard of the United States, has a climate tempered by the warm seas of the Pacific Ocean; the summers are hot and the winters almost free from frost, so that a large range of varieties of fruit and nuts can be cultivated out of doors as, for example, apples, apricots, cherries, figs, grapes, nectarines, peaches, pears, persimmons, plums, prunes, quinces, oranges, lemons, strawberries, blackberries, loganberries, raspberries, gooseberries, currants, olives, almonds, pecans and walnuts. It could not, of course, be claimed that all grow to perfection. Apples, oranges and pears are seen growing in the same locality, and sometimes in the same field, yet this arrangement must be due partly to the ambitions of the cultivator, for no one set of conditions can accommodate well all these kinds of fruits. Placed in sheltered positions between the Coast Range and the Cascade Range of mountains are numerous wide flat valleys, such as the Sacramento Valley and the Imperial Valley, where the soil is extremely fertile if only sufficient soil moisture can be provided to keep the plants growing. In most localities the heat of the summer sun is too intense and the normal rainfall is insufficient to maintain good plant growth. Irrigation is therefore almost universally practised, the water being taken from wells, rivers or even from the snow water from the glacier and high mountains of the Cascade. Under these conditions, California has been able to develop a fruit-growing industry of exceptionally large dimensions, though owing to the extreme length of the State the several fruit regions are far apart, that of the Imperial Valley in the south being fully 750 miles from the Shasta area in the

north—as far as Kent is from Inverness. Yet, as will appear later, the grading, packing and marketing of the deciduous fruits from all these widely separated areas is all done under the influence of one large growers' organisation. Each separate valley where fruit can be grown has its own peculiarities which have been exploited for the production of some special crop. There are thus a number of isolated areas important for the production of one, or at most two, crops.

With a helpful climate and fertile soils situated in sheltered valleys, the production of fruit even in large quantities was not a difficult matter: by no means was it as serious as the problem of marketing, and the difficulties of the earlier growers centred almost entirely around marketing. The difficulties were very great, on account of the vast distances to be covered before the fruits reached the markets. Thus, almost at the commencement, growers were drawn together to seek for an organisation whereby they might collectively overcome the obstacles of proper packing, transportation and marketing, which appeared to be too big for individual effort. Men came together, not from over the wide field of the whole State, but just a few here and there engaged in a similar industry and generally situated in the same locality; these banded together to work for the common good and formed small Growers' Associations to put the results of their deliberations into practice.

One of the earliest of these associations to be formed was the Sacramento River Association. It is located in one of the finest parts of the State for fruit growing, with a climate particularly favourable to the growing of deciduous fruits, and especially the William Bon Chrêtien, or Bartlett, pear.

This association at present includes about sixty growers and shippers, some of whom have been identified with the organisation since it was formed twenty years ago.

The association now operates three sheds for receiving fruit for assembling for eastern markets—the Sacramento Docks, Walnut Grove and Hood. Generally the members are engaged in farming large acreages of fruit and are able to establish their own packing sheds and to carry out the grading and packing of the fruit on the farms. At Hood, however, the association in 1923 found it necessary to erect a community packing house where the fruit could be graded, packed and sent out under uniform labels. This packing house, which is two storeys in height, is a fine type of construction, equipped with modern labour-saving facilities for the efficient handling of box

fruits, which consist mainly of William (syn. Bartlett) pears. The pears come to the house early in July, and are practically all harvested by 15th August. In the packing house, the pears are run through a mechanical sizer, whereby the bulk is sorted, either by weight or width, into different sizes. Girls pack direct from the bin, wrapping each pear in paper before placing it in the standard pear box, carrying out that operation in much the same manner as has been described for apples,* though perhaps a greater number of styles of pear packs are admitted to be commercial than are recognised for the apple. After leaving the packer, the pear boxes are fastened, labelled and checked before being assembled for delivery to the market.

Plums.—Plums, chiefly of the varieties Tragedy, Santa Rosa, and Formosa, rank next in importance. They also are well packed, though for grading and sizing no mechanical devices yet tried have proved successful. The tree-gathered plums are brought into the packing house and emptied on to packing tables, which are wooden frameworks usually fitted with burlap or canvas bottoms or with wooden bottoms padded with various materials. Any type of table that would prevent bruising appeared to give satisfaction. Here, girls sort and grade the plums and pack them, two layers deep, into square chip baskets (without handles) each holding 5 lb. of fruit. Four of these chip baskets fit side by side into a cheap wooden crate which bears the labels, name of variety and net weight. The standard market package of plums from California is then a 20 lb. crate, but retailers have four separate baskets in each crate, and—I am told—are able to sell most of this kind of fruit by the unbroken basket.

Cherries.—The sweet cherry (Knight Early Black, Burbank, Black Eagle, Black Tartarian, Bing, etc.), is picked when nearly mature—that is, when practically all the changing of starch to sugar has ceased, and the fruit has attained the colour characteristic for the variety—into galvanized iron water pails in which they are delivered to the packing houses, where they are emptied into the packing trays, the boys being careful to pour the cherries out gently. Here they are graded for colour and size and packed into "Cherry Boxes" holding 10 lb. or "Cherry Lug" of 20 lb. The empty box, turned with the face down, is placed so as to incline towards the packer at an angle of about thirty degrees. The girls then select cherries

* "Packing Apples in the Okanagan Valley, British Columbia": This *Journal*, Feb., 1925, p. 1034.

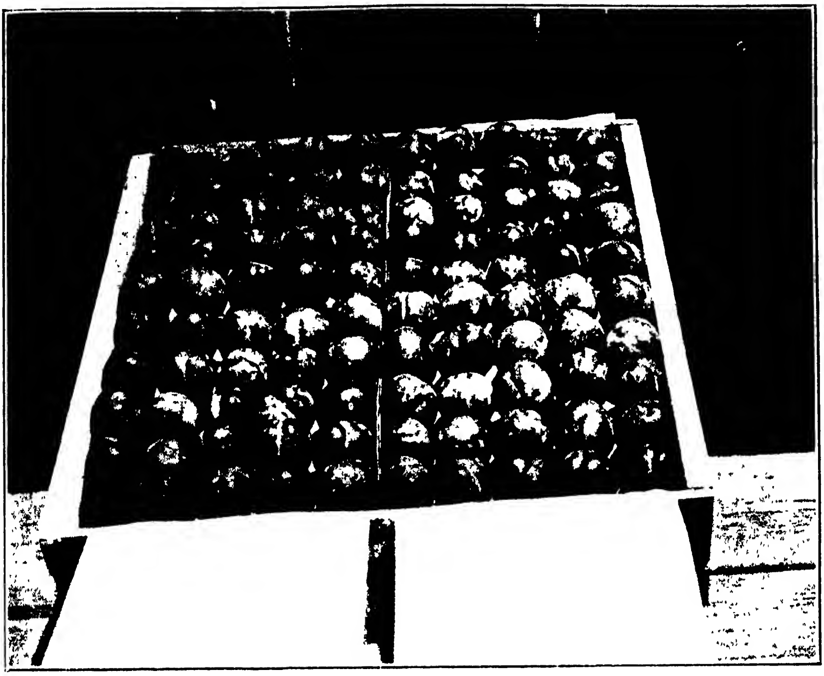

FIG. 1.—The standard market package of plums, containing 4 square chip baskets each holding 5 lb. of plums all of the same size and colour.

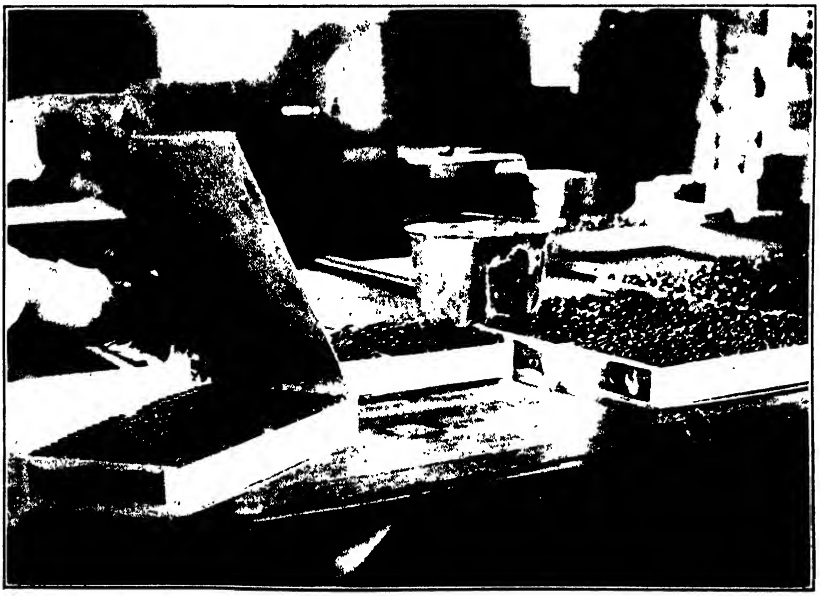

FIG. 2- The cherry box holds 10 lb. of fruit. The two top layers only are packed in definite order.

of the same size and colour and place these on their sides in proper alignment and with the stems towards the paper. Holding the fruit in position with one hand and selecting fruits with the other, the packer arranges the cherries in line across the box. Each successive row is placed in direct alignment (straight pack) with the preceding one. Having packed the first layer in this manner, the second layer is packed by placing cherries in the spaces formed by the first layer. When the second layer has been completed the box is placed on the level and filled with cherries without regard to definite alignment. The bottom of the pack is neatly finished off so that the corners and sides of the box are well filled and no fruits or stems extend over the edges of the box. The whole is covered with paper and the box is ready to leave the packing bench to be fastened, labelled and dispatched. At times, the very best fruits are packed in cartons, four of which exactly fit into the tin-framed box.

The Sacramento River Association operates over a comparatively small area. In other districts, similar associations operating in much the same way have been formed, so that in the whole State there must be nearly one hundred of these local associations, all working under standard by-laws, with such variations as may be necessary to suit local conditions; and all are said to be incorporated under the co-operative laws of the State of California, as non-stock non-profit associations.

Each local association elects its own Board of usually five Directors, with a President, Vice-President and Secretary, and appoints its own manager and packing-house employees.

The earliest formed societies had, no doubt, to make their own arrangements with the Railway Companies for the dispatch of the fruits to the markets and for their sale in the markets, but, by 1900, the deciduous fruit-growers in California had come to the conclusion that if the fruit industry was to survive, the system of marketing must be greatly improved and, in fact, the marketing of the whole produce centralised as far as possible in one exchange. The many local associations agreed to limit their functions to assembling, grading, packing and loading the fruit, and they agreed to co-operate in setting up a selling organisation—the California Fruit Exchange—to sell the produce for all societies. In 1907, this Exchange was reorganised on a capital stock basis, with a permissible capitalisation of $100,000 divided into one thousand shares of $100 par value. Provision was made for the distribution of

these shares amongst bona fide fruit-growers, though no man could hold more than two shares.

The associations have a combined membership of over 6,500 growers, so that the quantity of deciduous fruits sold for the growers by this one organisation is very large, as instanced by the following figures which have been given to the writer by the manager of the California Fruit Exchange.

Year.	*No. of Cars.*	*Gross Sales.*	*Net Returns.*
1920	5,596	$13,473,801	$8,666,178
1921	6,281	$12,680,295	$6,952,475
1922	8,560	$12,935,832	$8,280,069
1923	10,935	$17,173,124	$10,629,060

To deal efficiently with such a volume of business, quite a large staff is required at the central organisation. as, for example, a General Manager's Department, Sales Department, Accounting Department, Traffic Department, Claims Department, Supply Department, Standardisation Department and Lumber Department. (This Exchange is distinct from the California Fruit Growers' Exchange, which is a similar but larger organisation trading in citrus fruits.) Practically no fruit is sold f.o.b. in the producing centre, and in that respect their policy differs from that of all other exchanges previously described,* though the same method is adopted by the California Fruit Growers Exchange in selilng citrus fruits.

By contract with the California Fruit Growers' Exchange, the members of the California Fruit Exchange now utilise the marketing machinery which has been set up by the former for selling citrus fruits. The Exchange is represented by salaried agents in some eighty cities and towns, and in this way secures a wide distribution and fewer glutted markets. The price at which the fruit is to be sold in the towns is fixed by the sales department of the central organisation, and the salaried representatives in the towns attempt to sell in car-loads lots to wholesale merchants and others, or, failing that, they send the fruit for sale in the auction rooms, where they are able to attend the auctions and watch the prices. By having their own representatives in the markets the Central Exchange claim to be able to regulate their cars to the several markets in a more orderly manner ; to hold car-loads back in order to catch better markets; or to reconsign loaded cars in transit to markets found to be glutted, to others less well supplied. It is a system which is

* Apple Packing in Nova Scotia, this *Journal*, Dec., 1924, p. 856; "Packing Apples in British Columbia," Feb., 1925, p. 1034.

said to have worked splendidly for the citrus fruits, and seems to be giving satisfaction to the deciduous fruit growers. It is important to bear in mind that these salaried agents operate in the markets as brokers and not as distributors, *i.e.*, they sell in lots of a car-load which may be anything between 700 and 800 boxes. Their business is done with the wholesale merchants, and, so far as the writer is aware, no selling to retailers has ever been attempted, nor did the Exchange seem to think that such a course would prove desirable or even economical.

All grower members of the Fruit Exchange are charged 7 per cent. for marketing the fruit, which is said to be the usual rate charged by commercial companies engaged in the same line of business. The Exchange does business at cost, and the difference between the actual cost of doing business in any one season and the 7 per cent. charged goes into a "Withholdings Account." This "Withholdings Account" constitutes the operating fund of the organisation. At no time in the history of the Exchange has its cost of doing business been more than 3 per cent., and the average cost over a period of the last six years has been 2.72 per cent. As a usual thing, therefore, growers operating through the California Fruit Exchange have their business handled for about 3 per cent., and the remaining 4 per cent. is placed in the withholdings or operating fund, of which one-half is returned during the year immediately following the crop season and the other half at the expiration of five years. Thus, any grower who has been with the California Fruit Exchange for a period of five years receives back each year about 4 of the 7 per cent. deducted on the gross delivered selling price. This "Withholdings Repayable Account," now totalling $1,660,000, is seldom understood properly by the growers, but it seems a perfectly simple and sound plan for providing the working capital, and is preferable to borrowing from the Bank or to the issue of stock shares.

Year by year the Exchange seems to have increased its volume of business until at the present time it claims to be handling fully 45 per cent. of the total Californian production of deciduous fruits. Growers not making use of the Exchange have to make use of the selling organisations and packing stations of independent merchants, of which there are a large number at each fruit shipping point. The growers are, in fact. not tied to the Exchanges by contracts longer than twelve months, and in practice growers at times leave the Exchanges for a while and then sign on again. This freedom of action left to growers is advantageous and much appreciated.

The Central Organisation is also responsible for the purchase and distribution of practically all the material and equipment used in harvesting the crops throughout the State. It was, in fact, compelled at one stage during the War period, to enter the lumber business to secure material for making its fruit boxes, and now owns approximately 15,000 acres of timber, including saw mills, box factory, etc., a piece of business which has proved very profitable to the Associations.

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FURTHER OBSERVATIONS ON THE FOOD OF THE LITTLE OWL.

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MOST of the British resident species of raptorial birds, and particularly the owls, have been definitely classified as regards their potentiality for good or ill, but the case of the Little Owl (*Athene noctua vidalii*) is somewhat different; and as there still appears to be some doubt as to the economic status of this bird, and the question is one of considerable importance to agriculturists, a few observations from a field ornithologist may be of some value.

The subject has been dealt with by Dr. Collinge,* of the York Museum, far more exhaustively than has been possible by the writer, who is glad to find, however, that his conclusions closely resemble those arrived at by Dr. Collinge.

A brief résumé of the British history of the species may be of interest. Since Waterton's initial essay in 1842 numbers of these birds have been liberated from time to time by various ornithologists, notably the late Lord Lilford and Mr. E. G. B. Meade-Waldo, more as ornithological experiments than as serious attempts to establish the species in this country. Before Waterton's time the little owl was not a resident breeding species, and the few examples recorded may be presumed to have been stragglers from the Continent or escapes from aviaries, private or otherwise.

From the point of view of the species itself, these experiments were a distinct success; so much so, in fact, that in many districts it is now our commonest owl. The species has multiplied abundantly and is rapidly extending its range. At

* See "The Food and Feeding Habits of the Little Owl," by W. E. Collinge, this *Journal*, Feb., 1922, p. 1022; March, 1922, p. 1133 (including bibliography); and Nov., 1922, p. 750.

the present time it is plentiful in the Midland, Eastern and Southern Counties, and last year the writer found it quite common as far afield as South Devon.

FIG. 1.—The Little Owl (*about ½ nat. size*).

Generally speaking, the food of the little owl is much the same as that of the majority of British owls, but as this bird has been accused of extending its depredations to the game covert and the poultry yard, it is proposed to discuss briefly the evidence afforded by a series of observations.

As the little owl frequently hunts by day as well as at night, it must be admitted that its opportunities for harm are considerably greater than those of most owls, and, as already mentioned, it is significant that most of the complaints on this head emanate from gamekeepers and poultry farmers.

Apart from the examination of the stomachs of specimens, probably the most reliable methods of ascertaining the food of owls are :—

(1) Inspection of the remains found in the birds' nesting holes, and

(2) Systematic examination of the pellets cast up by the birds.

As regards method (1), out of some thirty nesting holes kept under observation at different periods, the writer has on two occasions found evidence of objectionable operations. The first item was the wing of a full grown partridge (a somewhat surprising find, and in view of the difficulties of size, weight and transport, possibly one better left out of consideration), the other being a week-old Wyandotte chick. This is a decidedly meagre result from the point of view of the prosecution, and one that would appear to show that the victims were the result of occasional lapses, rather than staple items of the owls' diet.

It must be admitted that this method has its defects, and that much more satisfactory results may be derived from dissection of the pellets. The results obtained by this latter means are extremely interesting. The tests covered a period of three years, were carried out in two counties, and concerned twelve nesting holes, all of which were visited at regular intervals during the breeding season, in districts where game and poultry are plentiful.

Below are given particulars of the contents of the pellets examined, together with the number of pellets examined at each nesting hole :—

No.	*County.*	*No. of Visits.*	*Total Pellets examined.*	*Contents of Pellets.*
1.	Kent	4	12	Bones and fur of small rodents, feathers and bones of house sparrow.
2.	,,	3	15	Bones and fur of rodents, bones of small bird (species not ascertained).
3.	,,	4	16	Bones and fur of rodents, fragments of shell of snail (apparently *H. aspersa*), elytra of carabid beetles.
4.	,,	3	9	Bones and fur of rodents, bones of small birds (finches).
5	,,	4	16	Bones and fur of rodents, numerous elytra of carabid beetles, wing bone of blackbird.
6.	,,	3	15	Bones and fur of rodents, bones of small fish (minnow).

No.	County.	No. of Visits.	Total Pellets examined.	Contents of Pellets.
7.	Essex	3	15	Bones and fur of rodents, numerous elytra of common cockchafer (*Melolontha vulgaris*), leg bones of sparrows.
8.	,,	4	12	Bones and fur of rodents, elytra of cockchafers, fragments of snail shells.
9.	,,	3	15	Bones and fur of rodents, portions of grit, elytra of beetles.
10.	,,	4	20	Bones and fur of rodents, skull of house sparrow, fragments of noctuid pupa cases, elytra of beetles.
11.	,,	4	12	Bones and fur of rodents, bones of common frog, elytra of various beetles.
12.	,,	4	16	Bones and fur of rodents, elytra of various beetles.

It will thus be seen that, in every nesting hole, the pellets examined contained the fur and bones of rodents, and the following is a summary of the remaining contents:—

In 8 nesting holes pellets contained wing cases of beetles.
,, 6 ,, ,, ,, ,, bones and feathers of small birds.
,, 2 ,, ,, ,, ,, fragments of snail shells.
,, 1 ,, ,, ,, ,, bones of small fish.
,, 1 ,, ,, ,, ,, bones of frog.

There would, of course, be no trace in the pellets of such soft food as earthworms and larvæ of insects.

As already mentioned, Dr. Collinge's series of tests was much more extensive and the results correspondingly more valuable, but the results tabulated above are of assistance in the task of determining the agricultural status of the little owl. Altogether, the results of investigations carried out by various ornithologists up to date may be said to show that the evidence in the bird's favour is strong.

It would be idle to deny that most of our raptores suffer occasional lapses in the matter of slaughtered domestic birds and young game, but the writer's opinion is that, so far as the owls are concerned, such instances are exceptional. It is to be hoped that the time is not far distant when the true value of our owls will be recognised generally, and it is gratifying to note that already much has been accomplished in this direction.

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MAY ON THE FARM.

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Arable Land.—Towards the end of May, or earlier in a dry warm season, the Turnip Fly may begin to infest turnip seedlings. Their sudden and mysterious appearance in large numbers was formerly attributed to the seed having contained the eggs; but it is now known that the beetles are about and breeding a month or two earlier in the year, feeding on cruciferous weeds such as charlock. They fly freely when the temperature of the air is in the neighbourhood of 70° F., and apparently they are attracted to the turnip crop by its scent. Possibly the protective virtue of soaking the seed in turpentine is attributable to its masking the natural odour of the crop. In favour of the practice may be mentioned the fact that soaking for about two days has no injurious effect on the growing properties of the seed but in fact slightly accelerates germination.

It is generally agreed that measures which enable the crop to reach the rough-leaf stage quickly are the best means of preventing destruction by this pest: a good tilth (*i.e.*, fine, firm, moist soil) containing a little superphosphate and nitrate of lime favours quick establishment of the plant. Rolling when the seedlings are through the ground will often assist, especially where the soil was rather dry and loose at sowing. I have also seen the beetles driven off by an application of sawdust containing paraffin. Dusting with noxious powders such as soot, basic slag, lime and sulphur has also been advocated and tried: in 1911 experiments were conducted by the East Anglian Institute and it was found that soot, sulphur and spent tan were of no remedial value; lime had a slightly beneficial effect; paraffin emulsion drove the beetles off for one day; but the application of 1 cwt. nitrate of lime per acre was attended with considerable success.

Mangold seeds and seedlings also have their insect enemies; but as these are not readily found by the farmer he rarely attributes a failure of the mangold plant to this cause. Drilling too deeply, lack of lime in the soil and the application of an excess of soluble fertilisers may account for failure, but insect attack is not uncommon. Each case of mangolds coming up unsatisfactorily or going away should be reported to the County Agricultural Organiser for investigation, with the assistance of the Provincial Advisory Officers where necessary.

The weather in May is as a rule favourable to the work of killing weeds, either by dragging them out of the ground and drying them on the surface in the case of free soils, or by drying the clods containing the weeds where the soil is of heavier texture. In the latter case, however, it may not be possible to sow until June. Under these conditions crops of deeper rooting habit and better drought resisting properties than swedes may be preferable, viz., common turnips and marrow stem kale. Both of these, as they cover the ground more quickly than swedes, may also be of advantage where quite satisfactory cleaning before sowing is impossible.

Regarding varieties of swedes, attention may again be directed to the existence of sorts which, on land infected with finger-and-toe disease, are less susceptible to injury by this pest than the ordinary varieties. Tipperary, a quick growing and heavy cropping purple-top swede, grows well out of the ground and thereby suffers less lamage than sorts in which the "root" is more deeply inserted in the soil. Two Danish strains of Bangholm, viz., No. 25 and No. 4, have been proved to possess considerable powers of resistance to the disease.*

May Pasture and Milk Yields.—Ordinarily the daily yield of a cow rises for a few weeks after calving then falls gradually with the advance of lactation until she goes dry, from the 38th to the 45th week, according to the date of service. In Fig. 1 are graphically represented the average daily yields at successive stages in the lactation of 95 cows which calved between 1st May and 30th June. The information embodied in the

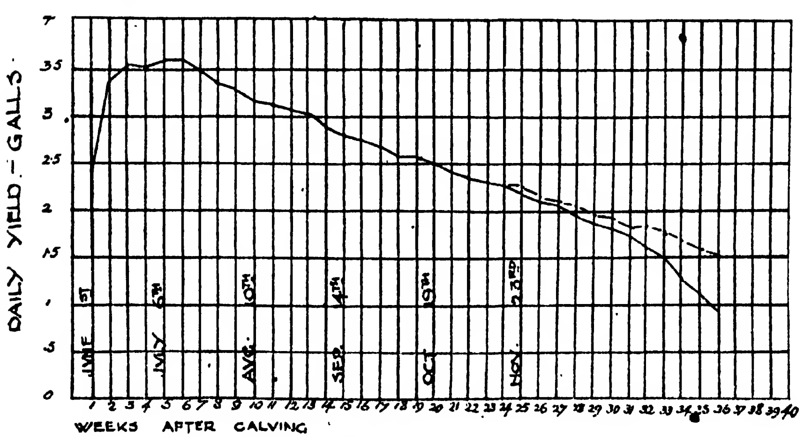

FIG. 1.—Variation in Milk Yield with advance of Lactation.

* See "Swedes Resistant to Finger-and-Toe," this *Journal*, July, 1922, p. 362.

curve was extracted by Gavin from the records of the Terling herd and published in the *Journal of Agricultural Science*, Vol. V, page 309.

In Fig. 1 the curve branches at the 24th week: the lower line represents the yields of cows served between the 9th and 12th week after calving, the depressing effect of pregnancy being apparent as an accelerated fall in yield from about the 14th week after conception. The upper curve shows the effect of deferring service for a further eight weeks. Besides the incidence of pregnancy, however, there are other influences which modify the yield curve for individual cows—the efficiency of the milkers, the condition of the animal at calving and the nature and quantity of the ration. An autumn or winter calver on going out to pasture in May "flushes" or increases her yield by 5 per cent. to 20 per cent. according to the winter feeding and management and the quality of the pasture to which she is transferred. The effect of May pasture on the daily yield of the winter calver is indeed an important consideration: a rise of 20 per cent. suggests that the winter ration has been defective or that the cows have had insufficient water; a fall or even the absence of a rise of 1 to 2 lb. in daily yield during the month of May would appear to indicate that the pasture land required improvement or that the winter diet had been excessively rich.

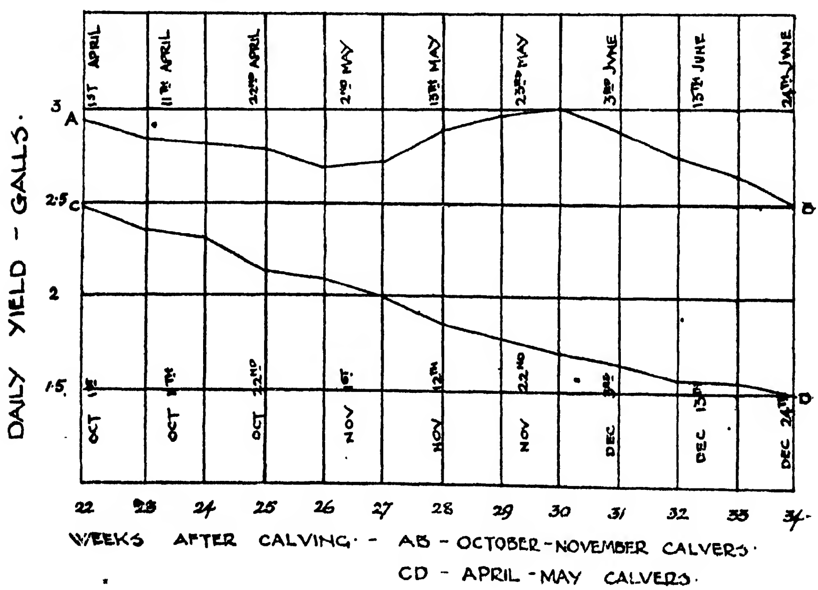

FIG. 2.—Effect of May Pasture on Milk Yield.

In Fig. 2 are represented the average daily yields in 89 lactations of cows in Mr. C. Fielding's (Matlock) herd of Lincoln Reds during the 6 years 1919-24. The upper curve, A.B., embodies the April to June part of 47 lactations, typically October-November calvers: their average yield per annum was 8,687 lb. The lower curve, C.D., embodies the autumn part of 42 lactations, typically April-May calvers with an average annual yield of 7,574 lb.

The increase in yield shown as due to pasture in the upper curve of Fig. 2, is greater than that normally associated with a change from efficient winter feeding and management to fair May grass. The curve represents, however, the yields during six years, in three of which the previous winter feeding was unavoidably unsatisfactory. During the three years 1918-20, concentrated foods were scarce and very expensive, linseed cake, for instance, being £20 or more per ton. During the next three years the herd received a properly balanced winter ration, fed slightly above the cows' requirements as measured by the accepted feeding standards. The following figures show the difference between the yields in the two series of years:—

		Years 1919-21	Years 1922-24	Years 1919-24
No. of lactations		22	25	47
Average No. of weeks calved...		21.7	21.5	21.6
Average yield per annum ...		7,888 lb.	9,391 lb.	8,687 lb.
Average yield per day :				
Indoors	April 1	26.5 lb.	31.8 lb.	29.3 lb.
	" 8	25.3 "	31.1 "	28.3 "
	" 15	25.1 "	30.7 "	28.1 "
	" 22	25.9 "	29.9 "	28.0 "
	" 29	24.9 "	28.7 "	26.9 "
	May 6	26.2 "	28.3 "	27.3 "
On Pasture	May 13	29.6 "	28.5 "	29.0 "
	" 20	30.0 "	29.5 "	29.8 "
	" 27	29.9 "	30.4 "	30.1 "
	June 3	28.5 "	29.2 "	28.9 "
	" 10	27.1 "	27.5 "	27.4 "
	" 17	26.1 "	26.8 "	24.4 "
	" 24	24.8 "	25.0 "	24.9 "

In the above averages and curves (Fig. 2), no lactation has been included in which the cow had calved within 6 weeks previous to 1st April or 1st October: the object of this was to exclude increases due to the natural tendency to rise in yield during the first few weeks of lactation.

The effect of May pasture on the quality of milk has not been studied so thoroughly as its effect on quantity. Generally some depression in quality might be expected to accompany a considerable rise in yield on going out to grass; and, under certain

conditions, the morning's milk might be found to contain less than the accepted standard of 3 per cent. of fat: this might be the case where the night interval between the milkings exceeded 13 hours and where the majority of the cows in the herd were spring calvers.

The Dairy Farm.—The following particulars are typical of a fairly well-stocked Derbyshire dairy holding of 100 acres:—

	Acres	*Live Stock*	*No.*	*Labour*	*No.*
Pasture	50	Dairy Herd	24	Men ...	2
Meadow	30	Young cattle ...	16	Youth ...	1
Arable	20	Work horses	3		

On many farms a greater proportion of permanent grass is mown, and where the head of winter stock is not heavy, there is a tendency to feed excessive quantities of hay. Ration records in this county have indicated that hay fed in excess of about 17 lb. per cow per day is not well utilised. In other cases where the proportion of mown land is high, young stock are sent away to summer ley instead of being grazed at home: the money so spent on ley would in many instances produce a better return if expended on phosphatic dressings to increase the stock-carrying capacity of the home pastures.

A correspondent has raised the question of whether in the case of a small farm even 30 per cent. is not too great a part of the farm to be devoted to the comparatively low-productive hay crop. He suggests that the smallholder at any rate might with advantage keep more cows by grazing the whole of his permanent grass land and buying the hay required for the maintenance of the herd in winter. The question involved is whether tending and milking cows is more remunerative than cultivating and making the hay crop. I believe that it would often pay the small farmer to adopt the above suggestion, with the modification that wet grains should be bought to take the place of part of the hay that would otherwise be grown or purchased. Instead of growing hay sufficient to provide a daily allowance of 16 lb., the winter ration might contain 14 lb. of wet grains and only 8 lb. of hay, either home-grown or bought.

If the same policy were adopted generally and on larger holdings, hay growing would soon be more profitable than milk production and wet grains would rise to prohibitive prices. Under present condition, however, and where the requisite buildings and demand for milk exist, the above policy would appear to be attractive. This may be shown by estimates of

the financial results of the ordinary and the suggested systems of management. On the typical holding cropped and stocked as first mentioned the principal items in the annual account are roughly as follows:—

Expenses	£	*Returns*	£
Rent and rates	250	Milk: 24 × 650 gal. @ 1/2 ...	910
Labour	260	Calves: 12 @ £3	36
Help in haymaking ...	10	Fat cows: 5·6 @ £24... ...	132
Concentrates: 24 × 15 cwt. @ 11/-	198	Corn: 10 acres @ £9	90
Horse corn	45		
Other expenses and profit ...	405		
	£1,168		£1,168

In the above example the average daily allowances of home-grown foods per cow equivalent during a winter of 190 days are:—roots (18 tons per acre), 33 lb.; hay (25 cwt.), 16 lb.; and straw (30 cwt.), 5 lb.

If the farm were cropped as 75 acres pasture and 25 acres arable, it would carry 30 cows and heifers and 20 young stock. The additional returns and expenses would probably be the following:—

Additional Expense	£	s.	*Additional Returns*	£	s.
Labour: third man in place of youth, less special hay labour	42	0	Milk: 6 × 650 gal. @ 1/2 ...	227	10
Concentrates: 6 @ £8 5s.	49	10	Calves: 5 @ £3	15	0
Hay: 40 × 8 lb. × 190 days = 27½ tons @ £4	109	0	Fat cows: 2 @ £24 ...	48	0
Wet grains: 40 × 14 lb. × 190 days = 47½ tons @ 25/- (6d. bus.)	59	8	Corn: 2½ acres @ £9 ...	22	10
Balance = advantage ...	53	2			
	£313	0		£313	0

No account has been taken of the manurial residues brought on to the farm in the purchased hay and grains: if properly conserved and utilised these would amount to a further advantage of £40 per annum. But without meadow land and with only 25 acres arable, it is doubtful whether proper use could be made of all the manure produced, viz., about 250 to 300 tons per annum. Better use of the manure is made where the farmer cultivates a greater acreage of crops that require liberal manuring—mangolds, marrow stem kale, potatoes or sugar beet. The system in fact lends itself to the inclusion of cash crops whereby manurial constituents are exported from the farm.

The main point of the above argument is that full use should be made of pasture: by slagging and by increasing the proportion of pasture at the expense of the hay land, increased numbers of cattle may be kept in summer: the limit may be set by labour considerations. As regards winter keep, I doubt whether any arable crop can be grown which will produce food at a less cost per unit than wet grains at 6d. per bushel delivered. The question of whether the dairy farmer could advantageously substitute part of his hay crop or replace part of his corn area with arable fodder crops—mixed cereals for hay or for silage, additional mangolds and marrow stem kale—is under investigation.

* * * * * *

MONTHLY NOTES ON FEEDING STUFFS.

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Water Consumption of Farm Animals.—A correspondent has raised an interesting and apparently simple question which is, however, more difficult to answer than would at first sight appear to be the case. The question was:—What is the daily quantity of water required by (1) a cow, (2) a year-old heifer, (3) a horse, during the grazing season? Simple though the question is, there appear to be few accurate data available upon which an answer can be based.

The water requirements of animals are met in several different ways. Firstly, a fair proportion of water is supplied in the food, particularly in the case of succulent feeding stuffs such as roots, grass and green forage crops. Thus, a bullock consuming 1 cwt. of roots receives over 9 gallons of water a day from this source. Concentrated feeding stuffs supply in the form of water about 1 gallon to 1½ gallons to every cwt., whereas grass and green succulent foods supply approximately 8 gallons of water for every cwt. of food consumed. The excess water required by the animal is generally obtained in the liquid form as drinking water. There is another source of water that is often overlooked, that is, water that results from the various chemical processes that go on in the animal's body. When starch, fat or protein is broken down in the animal's body, water is always an end product, and a certain amount of water becomes available for the animal's needs in this way. Thus

a pound of fat in breaking down in the animal's body yields more than its own weight of water, and a pound of starch or sugar similarly yields more than half its weight of water. This fact is illustrated by the interesting experiment of breeding weevils in desiccated flour, when it will be found that, although the larvae have never had access to water their bodies contain a large proportion of water, which can only have arisen from the chemical changes which have taken place in the food ingested.

The sources of gain of water to an animal are :—(1) Natural moisture in the food, (2) drinking water, and (3) water derived from metabolic processes. The sources of loss from the animal are :—(1) Water in dung and urine, and (2) water evaporated from the lungs and skin.

The amount of water consumed as drinking water will therefore largely depend upon the succulence of the food fed—the more succulent the food, the less drinking water will be required. The amount of water lost from the body will depend largely on the temperature of the animal's surroundings and the relative dryness of the atmosphere. This variable desire for water is well shown in the case of sheep. In the winter and spring sheep consume little or no water, whereas in a hot and dry summer special provision has to be made for drinking water for them. The demands of an animal for water will therefore vary considerably according to several factors—*i.e.*, dryness of atmosphere, temperature and state of succulence of the ration, and it is not possible to state accurately how much drinking water an animal will require. Kellner states an average based upon the dry matter of the food in the ration, *i.e.*, for horses, 2 to 3 lb. of water for every lb. of dry matter in the ration, and for cows 4-6 lb. of water for every lb. of dry matter in the ration. On this basis a horse eating 20 lb. of dry matter would require 6 gallons of water, and a cow eating 25 lb. dry matter would require 10 to 15 gallons of water a day. If roots or green succulent food were included in the ration, the demand for water would be considerably less.

In order to illustrate the distribution of water between the food, drinking water, urine and dung, the data obtained from an experiment carried out with oxen by Kellner nearly 30 years ago are of interest. Two full-grown oxen were used, one being fed with nearly 18 lb. of meadow hay, the other with nearly 20 lb. of a meadow hay and oat straw mixture. Both oxen drank daily 57 lb. of water, the food eaten contained approximately

DESCRIPTION.	Price per Qr. s. d.	lb.	Price per Ton. £ s	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit. Starch Equiv. s.	Price per lb. Starch Equiv. d.	Per cent of Digest. Crude Protein %
Wheat, British	—	—	12 5	0 16	11 9	71·6	3/2	1·70	10·2
Barley, British Feeding	—	—	9 10	0 12	8 18	71	2/6	1·34	6·5
„ Canadian :—									
No. 4 Western	36/3	400	10 3	0 12	9 11	71	2/8	1·43	6·5
„ Feeding	33/6	„	9 8	0 12	8 16	71	2/6	1·34	6·5
„ American	36/9	„	10 5	0 12	9 13	71	2/9	1·47	6·5
„ Danubian	36/0	„	10 2	0 12	9 10	71	2/8	1·43	6·5
„ Karachi	36/3	„	10 3	0 12	9 11	71	2/8	1·43	6·5
Oats, English, White	—	—	10 0	0 13	9 7	59·5	3/2	1·70	8·0
„ „ Black and Grey	—	—	9 13	0 13	9 0	59·5	3/0	1·61	8·0
„ Canadian :—									
No. 2 Western	30/9	320	10 15	0 13	10 2	59·5	3/5	1·83	8·0
Argentine	26/6	„	9 5	0 13	8 12	59·5	2/11	1·56	8·0
Chilian	28/3	„	9 18	0 13	9 5	59·5	3/1	1·65	8.0
Maize, Argentine	40/6	480	9 8	0 13	8 15	81	2/2	1·16	7·1
„ Australian	40/6	„	9 8	0 13	8 15	81	2/2	1·16	7·1
Beans, English Winter	—	—	10 15	1 12	9 3	67	2/9	1·47	20·1
„ Chinese „	—	—	11 10	1 12	9 18	67	2/11	1·56	20·1
Peas, English Maple	—	—	11 7	1 8	9 19	69	2/11	1·56	19·4
„ Japanese	—	—	23 15†	1 8	22 7	69	6/6	3·48	19·4
Dari, Egyptian	—	—	10 10	0 15	9 15	75·2	2/7	1·38	7·7
„ Persian	—	—	11 5	0 15	10 10	75·2	2/10	1·52	7 7
Millers' Offals :—									
Bran, British	—	—	7 5	1 7	5 18	45	2/7	1·38	10·9
„ Broad	—	—	8 15	1 7	7 8	45	3/3	1·74	10·9
Middlings—									
Fine Imported	—	—	9 0	1 2	7 18	72	2/3	1·20	12·6
Coarse, British	—	—	8 2	1 2	7 0	64	2/2	1·16	11·5
Pollards, Imported	—	—	7 2	1 7	5 15	60	1/11	1·03	11·6
Meal, Barley	—	—	11 12	0 12	11 0	71	3 1	1 65	6·5
„ Maize	—	—	10 10	0 13	9 17	81	2/5	1·29	7·1
„ „ South African	—	—	9 7†	0 13	8 14	81	2/2	1·16	7·1
„ „ Germ	—	—	9 0	0 19	8 1	85·3	1/11	1·03	18·4
„ „ Gluten Feed	—	—	10 5	1 7	8 18	75·6	2/4	1·25	20·0
„ Locust Bean	—	—	9 15	0 9	9 6	71·4	2/7	1·38	4·0
„ Bean	—	—	13 0	1 12	11 8	67	3/5	1·83	20·1
„ Fish	—	—	20 10	4 7	16 3	53	6/1	3·26	50·0
Linseed	—	—	22 7	1 11	20 16	119	3/6	1·87	19·4
„ Cake, English 12% Oil	—	—	13 15	1 18	11 17	74	3/2	1·70	25·3
„ „ 10% Oil	—	—	12 17	1 18	10 19	74	3/0	1·61	25·3
„ „ 9% Oil	—	—	12 12	1 18	10 14	74	2/11	1·56	25·3
Soya Bean Cake 6% Oil			10 15	2 14	8 1	69	2/4	1·25	38·2
Cottonseed Cake, English 5½% Oil	—	—	7 15	1 15	6 0	42	3/0	1·61	17·6
„ „ Egyptian 5½% Oil	—	—	7 10	1 15	5 15	42	2 9	1·47	17·6
Decorticated Cotton Seed Cake 7% Oil	—	—	12 17*	2 14	10 3	71	2/10	1·52	34·6
„ „ Meal 7% Oil	—	—	11 2	2 14	8 8	74	2/3	1·20	36.3
Ground Nut Cake 7% Oil	—	—	10 5*	1 16	8 9	56·8	3/0	1·61	42·0
Palm Kernel Cake 6% Oil	—	—	8 0†	1 3	6 17	75	1/10	0·98	17·1
„ „ Meal 2% Oil	—	—	8 0	1 4	6 16	71·3	1/11	1·03	17·1
Feeding Treacle	—	—	7 2	0 8	6 14	51	2/8	1·43	1·1
Brewers' Grains :—									
Dried Ale	—	—	8 0	1 4	6 16	49	2/9	1·47	14·0
„ Porter	—	—	7 10	1 4	6 6	49	2/7	1·38	14·0
Wet Ale	—	—	1 4	0 9	0 15	15	1/0	0·54	4.8
„ Porter	—	—	0 17	0 9	0 8	15	–/6	0 27	4·8
Malt Culms	—	—	8 5†	1 14	6 11	43	3/1	1·65	19·9

* At Bristol. † At Liverpool. ‡ At Hull.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of March and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 3s. per ton. The food value per ton is therefore £8 17s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices :—N, 13s. ; P_2O_5, 4s. 2d. K_2O, 2s. 6d.

$3\frac{1}{2}$ lb. of water, and the water in the dung and urine amounted to 50 lb. The total water ingested amounted therefore to approximately 6 gallons, and the water excreted in the dung and urine amounted to 5 gallons. The oxen averaged approximately 12 cwt. live weight and the room temperature was approximately 61° F. These figures are from an accurately controlled experiment, and indicate that a bullock fed on hay and roughage would require 6 gallons of water a day, but if the ration included 70 lb. of roots, the water in the ration would be sufficient for the animal's normal requirements.

FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat	1·16	2 2	71·6	7 15	0 16	8 11
Oats	1·16	2 2	59·5	6 9	0 13	7 2
Barley	1·16	2 2	71·0	7 14	0 12	8 6
Potatoes	1·16	2 2	18·0	1 19	0 4	2 3
Swedes	1·16	2 2	7·0	0 15	0 2	0 17
Mangolds	1·16	2 2	6·0	0 13	0 3	0 16
Beans	1·16	2 2	67·0	7 5	1 12	8 17
Good Meadow Hay	1·47	2 9	31·0	4 5	0 14	4 19
Good Oat Straw	1·47	2 9	17·0	2 7	0 7	2 14
Good Clover Hay	1·47	2 9	32·0	4 8	1 0	5 8
Vetch and Oat Silage	1·34	2 6	14·0	1 15	0 7	2 2
Barley Straw	1·47	2 9	19·5	2 14	0 6	3 0
Wheat Straw	1·47	2 9	11·0	1 10	0 4	1 14
Bean Straw	1·47	2 9	19·0	2 12	0 9	3 1

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt deliv ry.

DESCRIPTION	Average Pric per ton during week endin pril 15th.				
	Bristol	Hull	L'p	L'ndn	Cost per Unit at London
	£ s.	£ s.	£	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	13.15	13.17	13. 0	13. 0	16. 9
„ „ Lime (N. 13 per cent.)	...	12.10	..	12.12	19. 5
Sulphate of Ammonia, ordinary (N.20.7 per cent.)	13.11*	13.11*	13 11	13.11*	(N)13.1
„ „ „ neutral (N. 21.1 per cent.)	14.14*	14.14*	14.1	14.14*	(N)13.11
French Kainit (Pot. 20 per cent.)	3. 2	3. 0		2.15	2. 9
„ „ (Pot. 14 per cent.)	2.17	2.15	2.	2.10	3. 7
Potash Salts (Pot. 30 per cent.) ...	...	...	3.1	3.15	2. 6
„ „ (Pot. 20 per cent.)	...	...	2.1	2.12	2. 7
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7.10	7	7. 5	2.11
Sulphate of Potash (Pot. 48 per cent.) ...	12.10	11.15	11.	1.10	4. 9
Basic Slag (T.P. 30 per cent.)	3. 2§	...	2	2.12§	1. 9
„ „ (T.P. 28 per cent.)	...	2. 1‡		2.10§	1.10
„ „ (T.P. 26 per cent.)	...	1.14‡		2. 8§	1.10
„ „ (T.P. 24 per cent.)	...	1.11‡	2.	2. 6§	1.11
Superphosphate (S.P. 35 per cent.) ...	...	...	3.1	3. 8	1.11
„ (S.P. 30 per cent.) ...	3. 7	3. 5	3.	3. 2	2. 1
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	9.10	8. 5	8.1	8. 0	...
Steamed Bone Flour (N. ¾, T.P. 60 per cent.)	6.15†	7. 0†	6.1	6. 0†	...
Fish Guano (N. 7½-8½, T.P. 16-20 per cent.)	...	...	13.	...	...
„ „ (N. 9, T.P. 10 per cent.) ...	...	...	.	12. 5	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P. otal Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway statio

† Delivered (within a limited area) at purchaser's nearest rai y station.

‡ F.o.r. Works.

§ Prices include cost of carriage from works to town named, a l at London are for not less than 4-ton lots. Cost to purchasers in other distri will be greater or less according to the distances of different purchasers from e works.

* * * * * *

MISCELLANEOUS NOTES.

Individual Tests for Agricultural Machinery.

IN May, 1924, a Committee was appointed by the Ministry of Agriculture to formulate a scheme for testing agricultural machinery, as recommended by the Machinery Advisory Committee. That Committee has now worked out its scheme and presented it to the Ministry.

Besides providing for the tests, the scheme requires that official certificates and reports shall be issued which will give farmers, distributors and manufacturers accurate and independent information regarding the utility, efficiency, reliability, working cost, and maintenance of each machine or implement tested. Machinery and implements of either home manufacture or overseas manufacture submitted through an accredited

agent in this country will be eligible for testing, but scale models will not be admitted. The cost of testing will be borne by the entrant in accordance with a schedule of fees which has been drawn up by the Committee, and set out in an appendix to the report. The Committee has drawn up general regulations to govern the admission of machines and implements for testing, a form of entry, and forms of certificate and report to be issued by the Ministry. It is recommended also that a small permanent Committee should be appointed to assist the Ministry in carrying out the testing scheme.

The Ministry proposes to appoint a permanent Committee, as recommended, and is preparing the necessary forms and instructions for enabling applications for individual tests of machinery to be dealt with. It is not proposed to publish the Report, of which this is a short summary, but copies of it may be obtained on application to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

* * * * * *

The Importance of the Poultry Industry.

IN the Report on the Agricultural Production of England and Wales, recently issued by the Ministry,* the results of the returns so far as the production of poultry and eggs is concerned are summarised as follows:—

"The returns collected in 1924 show that the number of fowls on agricultural holdings in England and Wales was substantially greater than at the previous census in 1921. The number of fowls of a year old or more was 15,123,000, and of these approximately 13¾ millions would be hens. At an average annual production of 100 eggs per hen, the total production of eggs on agricultural holdings in England and Wales would be about 1,375 millions, against 1,100 millions, the estimated production in 1922. It must be remembered that these figures do not represent the total production of eggs in the country, as they do not include the produce from fowls kept by occupiers of less than an acre or those kept in towns or suburban areas. It has been previously suggested that an addition of about one-third should be made for fowls not on agricultural holdings, and on this basis, the total production of eggs in England and Wales in 1924 would be about 1,800 millions.

"In the Report for 1922 it was stated that the number of poultry killed for food in any year might be estimated as

* Agricultural Statistics, 1924, Vol. 59, Part II.

approximately equal to the number of poultry hatched in that year and alive on 4th June. The number of poultry reared on agricultural holdings and killed for food in 1924 may, therefore, be estimated at: Fowls, 15,630,000; ducks, 1,420,000; geese, 400,000; and turkeys, 535,000. The estimated number of fowls and turkeys killed was much greater in 1924 than in 1921."

Mr. Edward Brown, of the National Poultry Council, in a letter to *The Times*, 30th March, 1925, puts the value of the eggs and poultry consumed in Great Britain in 1924 at nearly 40 million pounds sterling, of which a little more than 17 million sterling was home-produced. He also puts the poultry industry as about equal in value of outturn with that of wheat-growing.

The Minister of Agriculture had already recognised the growing importance of the poultry industry, and has asked the National Farmers' Union and the Poultry Trade to nominate members to serve upon his Poultry Advisory Committee. Its Chairman is the Ministry's Poultry Commissioner, Mr. Percy Francis, and its other members are Mr. Edward Brown and Mr. W. Brownson (Joint Secretaries of National Poultry Council), Mr. Hedworth Foulkes, B.Sc., Mr. W. Hammett (Lancs.), Mr. Tom Newman (Secretary, Scientific Poultry Breeders' Association), Mr. S. Street-Porter (Eastern Counties), Mr. T. R. Robinson (Secretary, National Utility Poultry Society), Col. S. Sandbach (Wales), and Mr. A. T. Walker (Lancs.).

To this body is now added the name of Mr. Harry German, Past President of the National Farmers' Union and Chairman of the Cereals, Livestock and Wool Committee of the Union; and Mr. A. S. Juniper, and Mr. Ambrose Keevil, O.B.E., both of the Central Markets, West Smithfield, London, E.C., who are appointed to represent the trade.

The Agricultural Index Number.

PRICES of agricultural produce during March averaged 65 per cent. above those ruling in the corresponding month of 1911-13, as compared with 67 per cent. above in the previous month. Most commodities were cheaper than in February, and the decline of 2 points on the month was chiefly accounted for by the fall in grain prices and to the fact that the advances in fat cattle and sheep were not proportionally so large as in the base years.

In March, 1924, the percentage increase was 57 per cent. above pre-war level or 8 points lower than at present.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.	1925
January ...	200	183	75	68	61	70
February ...	195	167	79	63	61	67
March ...	189	150	77	59	57	65
April ...	202	149	70	54	53	—
May ...	180	119	71	54	56	—
June ...	175	112	68	51	58	—
July ...	186	112	72	53	52	—
August ...	193	131	67	54	59	—
September	202	116	57	56	60	—
October ...	194	86	59	51	63	—
November	193	79	62	53	64	—
December	184	76	59	56	63	—

Wheat declined in price, and on the average was 4d. per cwt. cheaper than in February, the index figure recording a drop of 4 points, but wheat remained comparatively dear at 79 per cent. above pre-war. Barley showed a much sharper fall, values declining by 1s. 4d. per cwt. on the month, while oats were reduced by 4d. per cwt. The index figure for barley declined from 59 to 45 per cent. above 1911-13, and is at exactly the same level as a year ago, while oats, which fell from 42 to 38 per cent. above the base years, are 1 point lower than in March, 1924.

Fat cattle and sheep were slightly dearer, but the increases were relatively less than in pre-war years, and the index numbers show a decline of 2 and 3 points respectively. Bacon pigs advanced in price from 11s. 1d. to 11s. 8d. and porkers from 11s. 10d. to 12s. 4d. per 14 lbs. stone, the index figure for baconers rising from 62 to 67 per cent. above that of the basic years, while porkers rose from 60 to 66 per cent. above.

Trade was quiet for dairy cattle and, on the average, prices were £1 5s. per head lower than in February, the index number falling 2 points on the month. Store sheep and pigs again advanced in value, and the former were more than twice as dear as in the base years, while store pigs were 47 per cent. dearer.

Butter prices declined 1d. per lb., the index number falling to 58 per cent. above 1911-13 as compared with 63 per cent. above a year ago. Eggs were 2d. per dozen cheaper than in March last year and declined by about 7d. per dozen as compared with February of this year, the percentage increase falling by 13 points to 49 per cent. above the pre-war price. Cheese

was 6s. per cwt. dearer than in the previous month, and the index figure rose 7 points. Milk, on the average, was slightly cheaper owing to a reduction in price of ½d. per gallon at Manchester, and the percentage increase fell to 82 per cent. above 1911-13.

Potatoes were rather cheaper than in the previous month, and as values usually advance in March the increase over pre-war years declined from 144 to 138 per cent. Several descriptions of vegetables became dearer, and the average for all kinds, not including potatoes, rose from 74 to 91 per cent. above the base years. Brussels sprouts were considerably dearer, prices advancing from 13s. 9d. to 18s. per cwt., the latter figure being 140 per cent. higher than in 1911-13, an increase of nearly 80 points on the month. Celery was unchanged in price, but with a fall in values in the base years the index figure shows an increase of over 20 points as compared with February. Onions sold at 12s. per cwt. as against 11s. in February, and at the former price were more than twice as dear as in 1911-13. Cauliflowers were 3d. per dozen dearer, but this increase was relatively less than in pre-war years, and the index number dropped about 20 points on the month. Cabbage again sold at 40 per cent. above 1911-13 prices.

Hay was about 2s. per ton cheaper than in February, and sold at slightly less than in the base years.

Index numbers of different commodities during recent months and in March, 1923 and 1924, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

Commodity.	1923. Mar.	1924. Mar.	1924. Dec.	1925. Jan.	1925. Feb.	1925. Mar.
Wheat ...	27	46	67	76	83	79
Barley ...	8	45	76	81	59	45
Oats	36	39	37	46	42	38
Fat cattle ...	54	52	44	52	53	51
Fat sheep ...	94	64	84	107	100	97
Baconers ..	69	26	49	57	62	67
Porkers ...	82	37	49	59	60	66
Dairy cows ...	58	64	55	53	50	48
Store cattle ...	31	41	37	43	46	43
Store sheep ...	92	85	85	102	100	104
Store pigs ...	136	45	38	49	48	47
Eggs... ...	55	68	51	82	62	49
Poultry ...	81	59	64	63	56	57
Milk	87	71	84	84	84	82
Butter ...	70	63	73	73	62	58
Cheese ...	95	71	51	49	50	57
Potatoes ...	—12*	173	166	152	144	138
Hay	42	1	2	1	0	—1*

* Decrease.

Stud Goat Scheme.

THE Scheme whereby smallholders and cottagers who keep milch goats have been obtaining the services of first-class stud goats for breeding purposes at a maximum fee of 5s., has proved so successful during the past season that it has been decided to continue it for another season. Although complete results are not yet to hand, it may be stated that during the season just ended, 75 stud goats were registered and 882 services given. It is hoped that these figures will be exceeded during the forthcoming season.

Stud goats complying with certain specified conditions are eligible for registration under the Scheme, particulars of which may be obtained from the British Goat Society which is administering the Scheme. Goat owners are reminded that applications for the registration of stud goats should be made direct to the Hon. Secretary, British Goat Society, 10, Lloyd's Avenue, E.C.3, not later than 1st June. It is *not* necessary that such applicants should be members of the Society.

* * * * * *

International Congress of Agriculture.

THE Twelfth International Congress of Agriculture will be held in Warsaw from 21st to 24th June, 1925. The Congress will be composed of official delegates of Governments and of agricultural institutions and organisations belonging to countries which are represented on the International Commission of Agriculture. The programme of the Congress has been divided into five sections—rural economy, crop production, livestock production, agricultural industries, agricultural research and education. Each section will deal with no more than 5 to 7 problems.

The fee for members of the Congress has been fixed at 10 zloty (30 French francs), which gives the right to take part in all the sittings and receive copies of the general report of the Congress free of charge. The languages to be employed for verbal communications will be Polish, French and English. Up to the middle of March over one hundred papers from sixteen different countries had been promised to the Congress.

The Congress will be followed by an excursion from 25th to 29th June, at a fixed price, to agricultural enterprises, experimental fields, agricultural schools, exhibitions, etc., as well as to interesting parts and beauty spots in Poland, including the famous virgin forest of Bialowieza and Cracow—" a gem of the middle ages."

Visits to Rothamsted Experimental Station.

THE Director of the Rothamsted Experimental Station, Sir John Russell, again extends a cordial invitation to farmers' and farm workers' associations and clubs, chambers of agriculture and horticulture, students' societies and other bodies interested in agriculture or market gardening to inspect the Rothamsted Experimental Plots during the coming summer. Mr. H. V. Garner, B.A. (Camb.), will be available to demonstrate the Plots at any time, and all who come can be certain that under his guidance their visit will prove both useful and interesting.

Among important items of interest are: experiments on the manuring of arable crops, especially wheat, barley, mangolds, potatoes; manuring of meadow hay; effect of modern slags and mineral phosphates on grazing land, hay land, and arable crops; crop diseases and pests; demonstrations of good types of tillages. At any convenient time from May to 30th October there is sufficient to occupy a full day, and there is provision for assuring that the time shall not be lost, even if the weather turns out too bad to allow of close investigation of the fields.

Sir John Russell will be happy to arrange full details with organisations of farmers, farm workers and others wishing to accept this invitation; small groups of farmers are specially welcomed. If possible, arrangements should be made beforehand; but it is recognised that farmers' movements must often depend on the weather, and no farmer need stay away because he has been unable to write fixing a date.

All communications and requests to visit the Station should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden. It would be a convenience if ample notice could be given so as to avoid the possibility of dates clashing.

* * * * * *

Foot-and-Mouth Disease.—Only two fresh outbreaks of the disease have been discovered since the publication of the April issue of the *Journal*. These were at Wadsley Bridge, near Sheffield, on 26th March. The usual restrictions were imposed on the movement of animals and the holding of markets, etc., in areas of about 15 miles radius round these outbreaks. All restrictions in connection with the former outbreak have now been withdrawn.

* * * * * *

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Punnett, R. C.—Sex-Linkage for Egg Production and Table Poultry. (32 pp.) London: "Daily Mail," 1925, 1s. [63.651; 575.1.]

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Part I. The Law of Diminishing Increment.
Part II. The Law of the Soil.
(178 pp.) New York: World Book Co.; London: Harrap, 1924. [338.1.]

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U.S. Department of Agriculture.—Dept. Bull. 1302 :—Development and Present Status of Farmers' Co-operative Business Organisations. (76 pp.) Washington, 1924. [334(73).]

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The History of Agriculture in Wales, *C. Bryner Jones*. (Welsh Jour. Agr., vol. i, No. 1 (Jan., 1925), pp. 5-16.) [63(09); 63(42).]

Field Experiments with Various Types of Phosphatic Manures, 1924. (Jour. Dept. Lands and Agr. (Dublin), vol. xxiv, No. 4 (Feb., 1925), pp. 424-433.) [63.1672.]

Spraying for Weed Eradication, *W. E. Brenchley*. (Jour. Bath and W. and S. Counties Soc., vol. xix (1924-25), pp. 1-20.) [63.259.]

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Potato Growing for Seed Purposes, *W. D. Davidson*. (Jour. Dept. Lands and Agr. (Dublin), vol. xxiv, No. 4 (Feb., 1925), pp. 374-428.) [63.512.]

Seed Mixtures for Temporary Grass: Investigations Conducted in Denmark and Sweden, and Observations on Trials of a similar nature in progress at Aberystwyth, *R. G. Stapledon* and *R. Jones*. (Welsh Jour. Agr., vol. i, No. 1 (Jan., 1925), pp. 60-98.) [63.33(*b*).]

The Improvement of Poor Pastures with Special Reference to the Manuring of Acid Pastures, *T. Wallace*. (Jour. Bath and W. and S. Counties Soc., vol. xix (1924-25), pp. 77-89.) [63.33-16.]

The Basket Willow Crop as a Means of Utilising Wet Land, *H. P. Hutchinson*. (Jour. Bath and W. and S. Counties Soc., vol. xix (1924-25), pp. 49-57.) [63.3412.]

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Recent Developments in Commercial Fruit Culture, *E. M. Bear*. (Jour. Bath and W. and S. Counties Soc., vol. xix (1924-25), pp. 34-49.) [63.41.]

Apple Packing Station: Progress in England, *H. V. Taylor*. (Jour. Pomol. and Hort. Sci., vol. iv, No. 2 (Jan., 1925), pp.113-116.) [63.41-198.]

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Field Observations on the Incidence of Leaf Scorch upon the Apple, *R. G. Hatton* and *N. H. Grubb*. (Jour. Pomol. and Hort. Sci., vol. iv, No. 2 (Jan., 1925), pp. 65-77.) [63.21.]

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Dry Treatment for Smut Diseases of Cereals, *K. Sampson* and *D. W. Davies*. (Welsh Jour. Agr., vol. i, No. 1 (Jan., 1925), pp. 169-176.) [63.24.]

Egg-Killing Washes, *A. H. Lees*. (Jour. Pomol. and Hort. Sci., vol. iv, No. 2 (Jan., 1925), pp. 113-116.) [63.295.]

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The Use of Cod Liver Oil for Farm Stock, *J. Golding*. (Essex County Farmers' Union Year Book, 1925, pp. 191-196.) [612.394; 63.60492.]

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Feeding the Cow According to her Yield, *J. Wilson*. (Jour. Dept. Lands and Agr. (Dublin), vol. xxiv, No. 4 (Feb., 1925), pp. 343-350.) [63.711 : 043.]

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What is Wrong with British Agriculture?, *A. G. Ruston*. (Essex County Farmers' Union Year Book, 1925, pp. 239-248.) [338.58; 338.1(42).]

Farm Costings, *J. M. Adams*. (Jour. Dept. Lands and Agr. (Dublin), vol. xxiv, No. 4 (Feb., 1925), pp. 351-373.) [338.58; 338.1(415).]

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NOTES FOR THE MONTH.

Report of Committee on Stabilisation of Agricultural Prices.

THE Ministry has issued as the second of its series of reports on economic questions relating to agriculture, a report by a committee appointed by the late Minister of Agriculture to consider the problem of the Stabilisation of Agricultural Prices.* The subject is one of the highest importance to British agriculturists, and the Report which deals with it opens up new fields for thought and inquiry into the complex economic conditions which surround British agriculture. It is to be hoped that persons who are interested in the modern organisation of agriculture will not fail to give these problems due attention.

The Report analyses the many causes which bring about fluctuations in the prices of agricultural commodities, and the harm which these fluctuations cause, showing in a striking manner that not only in recent years but in earlier periods of agricultural history, a sharp or prolonged rise in the purchasing power of money has had serious and sometimes disastrous consequences to agriculture. Generally, it favours a policy of monetary stabilisation on the lines of the financial resolutions of the Genoa Conference held in 1922, and recommends that steps should be taken to put this policy into practice.

The remainder of the Report deals with fluctuations in prices due to conditions of supply and demand. It shows how agriculture suffers in a peculiar degree from the fact that demand is relatively steady, while supply, depending as it does on conditions beyond the control of the grower, is liable to vary very widely. A striking example of this and its effects on prices is shown in the case of hops. Potatoes, eggs, fruit and vegetables, and indeed most other agricultural products, are liable to suffer similar fluctuations in a greater or less degree. The possible remedies are next considered, and attention called to the almost universal movement towards the centralisation of

* Obtainable from H.M. Stationery Office. Kingsway, W.C.2. price 1s. 6d. net, 1s. 7½d. post free.

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marketing in agriculture, and particularly to the great advances made in this direction in the United States and the Dominions.

Co-operative marketing on certain lines can, it is suggested, be applied in this country so as to diminish the harmful consequences of wide price fluctuations, and the Report puts forward the suggestion that what the Americans call "orderly marketing" might, if applied to commodities mainly produced in this country, be successful in creating a more even flow of agricultural produce to market. As regards marketing foodstuffs which are mainly imported from abroad, the possibilities of establishing a more stable system in regard to them are briefly reviewed and discussed.

* * * * * *

Annual Returns of Crops and Live Stock.

THE annual agricultural returns will be collected again this year on 4th June. The forms were issued at the end of May to all occupiers of agricultural holdings, and the returns should be made and forwarded without delay to the Crop Reporter, whose address appears on the back of the form.

These returns afford the only real measure of the dimensions of the agricultural industry, and of the changes in cultivation and the number of live stock from year to year. The tabulated results are the more valuable the earlier they can be published, and all occupiers of agricultural land are urged to complete their returns at the proper date.

This year additional questions are included in the forms, with a view of obtaining information that is necessary in connection with the Census of Production. These questions relate to the production of milk, dairy produce, poultry and eggs and to the births and deaths of live stock during the past year. It is hoped that occupiers of agricultural holdings will furnish this additional information as completely as possible.

The returns of individual occupiers will be treated as confidential, and will be used only for the compilation of statistics of economic value to agriculture.

* * * * * *

Land Drainage Exhibit at Wembley.

WITH reference to the Ministry's Research Exhibit in the Government Pavilion at the British Empire Exhibition (see this *Journal*, May, 1925, p. 103) it may be said that a question of outstanding importance in relation to increased production, and the health of man and his live stock, is that of land drainage. The Ministry has therefore introduced a special

model relating to land drainage. This exhibit has been prepared for the purpose of enlightening the man in the street as to the manifold and complicated problems of land drainage. The model, which is some 20 ft. long by 18 ft. wide, is divided longitudinally into halves in order to enable the greatest length of river to be compressed within the limited space available. It is not intended to be representative of any given river in this country, but to depict features which are common to several rivers.

One half of the model shows about $1\frac{1}{2}$ miles of the outfall end of a tidal river, first emerging from a painted background, then flowing through low-lying marsh-lands and finally entering the sea. In this section of the model it has been found possible to include an indication of defence works, in the form of groynes and training walls, necessary not only to maintain the coastline, but also to prevent the river mouth from becoming silted up. As the countryside through which the section of river flows comprises fen-lands many feet under the level of high tides, it will be seen that protection against daily inundation can only be secured by earthen embankments along the river and the sea, and that the liability to flooding therefore increases according to the neglect to dredge the river or keep the embankments in proper repair.

Another feature introduced into this section of the model shows the desirability of dealing with acute bends on the course of a river by possible straightening, in order to produce a more rapid flow, which is the only means of securing the proper scouring essential to enable a river to evacuate itself with each tide. In this section of the model are also indicated the two methods of draining low lands into adjacent arterial channels: (1) by gravitation through sluices at low tides, and (2) by pumping over embankments. The range of three tidal sluices in the foreground is typical of several such structures existing in different localities protecting extensive areas from possible inundation.

In the other half of the model is shown an upland length of the same river, flowing through a valley of water-logged land, subject to frequent flooding, involving the loss of pasturage, crops and live stock by drowning and disease. This half of the model is designed to indicate generally the character of the country through which the tributaries of the main English rivers flow, conveying silt for long distances to the main channel.

Another feature introduced is a length of navigable canal, the existence of which almost invariably obstructs the natural drainage of the countryside, and not infrequently brings about the waterlogging of land by seepage through embankments and by the voiding of great quantities of excess water over weirs which overtax the original river. The main feature, however, is the neglected condition of the old river, with its fallen trees and sinuous bends, these being typical of the condition of many rivers in this country, particularly where water-power mills are in disuse, and the water wheels and gates being inoperative and dilapidated. Conditions are even more detrimental to agriculture where the navigation on a canalised river is derelict. Such conditions as those indicated have in many localities produced perpetual flooding on many rivers, a state of things to which the inhabitants have now resigned themselves, even to the extent of providing permanent elevated gangways as a means of crossing floods which ought not to occur at all.

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The Ministry's Annual Report on the Prices and Supplies of Agricultural Produce and Requirements is now in the press and will be issued very shortly.

Prices and Supplies of Agricultural Produce and Requirements in 1924-25.

The Report reviews the price movements of the different commodities during 1924, and, by means of index numbers, compares prices over several years. The tendency towards stability in the prices of agricultural produce which was noticeable in 1923 has been followed in 1924 by a rise which, in the case of certain products, has been quite substantial, and during the 7 months September, 1924, to March, 1925, the general level of the prices of agricultural produce was 65 per cent. above pre-war. Prices of feeding stuffs advanced last summer, and during the 7 months above mentioned were at 64 per cent. above pre-war. Changes in the prices of fertilisers and seeds are also given. The effect of the new minimum rates of agricultural wages as fixed by the Agricultural Wages Committees is shown to have raised the average level of wages of ordinary agricultural workers by 8s. per week by March of this year.

The Report contains information as to the proportions of the estimated total supply of the chief agricultural commodities

which are home produced or imported from the Irish Free State, other British Possessions and foreign countries respectively, and brings out clearly the extent of the dependence of Great Britain on imports of different commodities.

The position as regards the provision of weighing machines for the weighing of live stock at markets is reviewed in the Report, and it is mentioned that a Bill has been drafted with a view to making it compulsory to weigh all fat cattle exposed for sale by auction at markets where a weighbridge is provided under the provisions of the Markets and Fairs (Weighing of Cattle) Acts, 1887 to 1891. The introduction of legislation for the compulsory weighing of fat cattle has been considered by the National Farmers' Union and the Council of Agriculture, and both bodies have expressed themselves in its favour.

The Report, which forms Part III of the Agricultural Statistics, 1924, is published by H.M. Stationery Office, and may be purchased through any bookseller, price 1s. 6d., or direct from H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2, price 1s. 7d. post free.

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White Clover.

THE Ministry has just published a new Miscellaneous Publication on "White Clover,"* which has been written by Mr. W. M. Ware, M.Sc., of the South-Eastern Agricultural College, Wye. It embodies the results of a study of the subject which has been carried out at Wye, Kent. The history, cultivation and properties of various strains of white clover are carefully discussed, and much useful and practical advice is given, particularly in regard to cultivation for seed and the harvesting of the crop. The important points to be considered in the purchase and sale of white clover seed are also fully dealt with. In the seed-growing districts white clover has certainly proved a useful source of income to many farmers, and has given better returns than other seed crops, such as cereals, mangolds, turnips, etc.—a circumstance which no doubt goes far to explain its present-day popularity.

The author makes a passing reference to the fact that much of the uncertainty experienced by purchasers as to the nature of the stocks of wild white clover they are offered might be removed if the growers could find it practicable to form County Associations similar to those already operative to safeguard the reputation of true strains of red clover in this country. This is

* Miscellaneous Publications, No. 46, obtainable from the Ministry's Office, 10, Whitehall Place, London, S.W. 1, price 6d. net (post free).

a suggestion which merits careful consideration. The formation of a Wild White Clover Growers' Association, with strict regulations as to certification of stocks, would doubtless prove a far better means for dealing with the question of genuineness than would penal regulations.

Attention may also be drawn to the fact that the presence of a high proportion of hard seeds in wild white clover is an indication that the seed was taken from really old pasture. The Seeds Regulations, 1922, made under the Seeds Act, 1920, require the percentage of hard seeds to be stated separately from the percentage of germination. The Seeds Regulations also require a statement to be made as to the percentage of Suckling Clover present in a lot of Wild White Clover when it is present to the extent of more than 2 per cent. by weight.

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Unemployment Insurance for Agricultural Workers: Departmental Committee Appointed.

THE Minister of Agriculture and Fisheries and the Secretary for Scotland have appointed Sir R. Henry Rew, K.C.B., Mr. John Beard, Mr. David Black, Sir Thomas Davies, M.P., Mr. Thomas Denholm, Mr. James Falconer, Mr. James Gardner, Mr. Thomas H. Ryland, Mrs. Lucy Deane Streatfeild, C.B.E., Mr. R. B. Walker and Mr. Denton Woodhead to be a Committee to consider and report whether it is desirable that workers in agriculture should be compulsorily insured against the risk of unemployment, and, if so, on what terms and conditions, and in what manner the insurance of agricultural workers can be most effectively provided, either by the inclusion of agriculture within the scope of existing legislation, or by means of new legislation.

Sir R. Henry Rew, K.C.B., has been appointed Chairman of the Committee and Mr. R. E. Stanley, of the Ministry of Agriculture and Fisheries, and Mr. F. W. Charlton, of the Ministry of Labour, Joint Secretaries.

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The Agricultural Index Number.

THE general level of the prices of agricultural produce was further reduced during April, the index number showing that prices were 58 per cent. above the corresponding month of 1911-13 against 65 per cent. in March. The index number was, however, 5 points higher than in April last year and 4 points above April, 1923, this being the eighth month in which prices of

agricultural produce have been higher than in either of the previous two years. The decline of 7 points recorded in April was due mainly to the lower prices of grain and milk and the sharp fall in the index number of potatoes owing to the comparatively greater increase in potato prices in the base years.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920 :—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.	1925
January ...	200	183	75	68	61	70
February ...	195	67	79	63	61	67
March ...	189	50	77	59	57	65
April ...	202	49	70	54	53	58
May ...	180	119	71	54	56	—
June ...	175	112	68	51	58	—
July ...	186	112	72	53	52	—
August ...	193	131	67	54	59	—
September	202	116	57	56	60	—
October ...	194	85	59	51	63	—
November	193	79	62	53	64	—
December	184	76	59	56	63	—

Wheat averaged 12s. 3d. per cwt. during April, a reduction of 1s. on the month, and the index number dropped by 17 points to 62 per cent. above 1911-13, and was back to the level of last September. Barley, of which the great bulk on the market would be of feeding quality, averaged 10s. 7d. per cwt., or only 38 per cent. above pre-war, and was 9d. per cwt. lower than in April, 1924. Oats also became rather cheaper last month, but realised practically the same as a year earlier.

Prices of fat stock have been very steady on the whole, and the index numbers show very little change from last month. The average price of fat cattle advanced by 2d. per 14 lb. stone, but this rise was relatively rather less than in pre-war years and the index number was reduced by 1 point. The opposite occurred with fat sheep, the reduction of ½d. per lb. as compared with March, being relatively rather less than in 1911-13, and the index number advanced 3 points. Both bacon and pork pigs averaged 1d. per stone more than in March. As compared with last year, fat cattle realised much the same prices, but sheep and pigs were appreciably dearer, pork pigs having advanced by 2s. 1d. and bacon pigs by 2s. 8d., per 14 lb. stone.

Dairy cattle continued the fall in prices which has now lasted for six months and were about £3 per head cheaper than in April, 1924, and only 47 per cent. above 1911-13. Store cattle, although 5s. per head dearer than in March, showed a relatively smaller advance than usual at this season of the year, and the

index number was reduced to only 39 per cent. above pre-war, or practically the same level as a year earlier. Store sheep, as fat sheep, were at exactly double the pre-war price, and the sharp rise in store pigs brought these to relatively nearly as high a level as fat pigs.

The summer prices of milk are not so much above those of 1911-13 as the winter prices, and the index number fell from 82 per cent. above pre-war in March to 58 per cent. above during April. The reduction of ¾d. per lb. in the case of butter was relatively less than in 1911-13, and the index number rose by 6 points, while the increase of 3s. 6d. per cwt. for cheese caused the index figure to rise by 4 points. Butter was 1¾d. per lb. dearer than in April, 1924, but cheese was cheaper by 7s. per cwt. Egg prices were about ¼d. per dozen higher than a year ago, and although they declined by 1d. per dozen as compared with March the index figure was slightly higher.

Potatoes were 10s. per ton dearer in April than in the previous month, but in the base years there was an advance of 12s. 6d. in April and the index number was consequently appreciably smaller, although still high at 115 per cent. above 1911-13. Hay remained practically unchanged at pre-war prices. Cabbage averaged 45 per cent. above pre-war, and cauliflowers 87 per cent. above, but carrots remained relatively very cheap at only 11 per cent. above 1911-13.

Index numbers of different commodities during recent months and in April, 1923 and 1924, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

Commodity.	1923. April.	1924. April.	1925. Jan.	1925. Feb.	1925. Mar.	1925. April.
Wheat ...	31	38	76	83	79	62
Barley ...	11	48	81	59	45	38
Oats	39	35	46	42	38	34
Fat cattle ...	51	49	52	53	51	50
Fat sheep ...	100	75	107	100	97	100
Baconers .	63	30	57	62	67	68
Porkers ...	78	39	59	60	66	67
Dairy cows ...	55	63	53	50	48	47
Store cattle ...	29	38	43	46	43	39
Store sheep ...	92	84	102	100	104	100
Store pigs ...	131	42	49	48	47	64
Eggs... ...	37	48	82	62	49	51
Poultry ...	75	70	63	56	57	50
Milk	70	58	84	84	82	58
Butter ...	68	51	73	62	58	64
Cheese ...	92	71	49	50	57	61
Potatoes ...	—28*	154	152	144	138	115
Hay	40	0	1	0	—1*	—2*

* Decrease.

Agricultural and Veterinary Research Scholarships.

THE Ministry invites applications for research scholarships in agricultural and veterinary science. The number to be awarded will depend upon the qualifications of the candidates, and will not in any case exceed seven. The scholarships are tenable for three years from 1st October, 1925, and are of the value of £200 per annum. Applications must be received not later than 30th June, 1925. on the prescribed form (900/T.G.), which, together with a copy of the conditions attaching to the scholarships, may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

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Travelling Research Fellowships.

THE Ministry has awarded the following travelling research fellowships to enable members of its Research and Advisory Institutes to visit foreign and Colonial Agricultural Institutes and Stations in order to familiarise themselves with work collateral with their own which is being carried out in other countries.

Fellow.	*Value of Fellowship.* £
1. Dr. A. D. Imms of the Plant Pathology Research Institute, Rothamsted Experimental Station: Visit to U.S.A. and Canada to gain experience in entomological and general biological work ...	250
2. Mr. A. Appleyard of the Bristol University Fruit and Vegetable Preserving Research Station: Visit to U.S.A., Canada and France to study the canning of fruit and vegetables	250
3. Mr. A. M. Massee of the East Malling Fruit Research Station: Visit to Austria to study Plant Mites (*Eriophyidae*)	50
4. Mr. W. M. Williams of the Institute of Agricultural Engineering, Oxford: Visit to France and Italy to study Agricultural Engineering Research and Advisory Work, Testing of Agricultural Machinery, etc.	60
5 Mr. H. R. Davidson of the School of Agriculture, Cambridge: Visit to Denmark for the purpose of studying Animal Husbandry	20
Total	£630

THE PRINCIPLES OF AGRICULTURAL EXPERIMENTS.

SIR A. D. HALL, K.C.B., LL.D., F.R.S.,*

Chief Scientific Adviser to the Ministry of Agriculture and Fisheries.

THE particular point to which I am going to address myself can best be phrased in the famous introduction to one of Bacon's Essays: "What is Truth." How are we going to get at truth in our experiments? We find that we have to examine our experiments very carefully before they will yield us truth. In agriculture we have particularly tried to arrive at results by experiments, and one of the earliest forms which our experiments have taken has been to try and show upon the land how much better one variety of a farm crop, like wheat, may be than another, or how much better one treatment—be it by manure or by cultivation—may be than another, by putting down plots, side by side. We have the replica of the plot experiment when we come to examine questions of feeding. We have been accustomed to put a certain number of pigs or bullocks on one kind of diet and compare their rate of increase with that on another kind of diet. It will be familiar to many that the results obtained by this method of putting down plots and measuring the weights of their crops, are rather apt to be disappointing and sometimes confusing, for when we design the experiment we have a pretty clear idea of what the results ought to be, and yet the results have often not come out right. Various devices have been adopted by myself and my colleagues for camouflaging those kinds of results. Sometimes we have tried to explain them away, and given reasons for their occurrence. We have not always realised, I think, that those irregular results, as we might call them, were only to be expected. The present conference has been called to deal with this point. The central idea that I want you to perceive is that error is a normal circumstance of human life. We must accept this error but we can discount it, and we can reduce it to reasonable dimensions. The necessity of taking error into account arises from the fact that we are dealing, in agriculture, with living organisms, either plants or animals, and they are susceptible to an amount of variability that does not appertain to steel or iron or materials of that description. Even in the study of these

* Discourse delivered at the Conference of Agricultural Organisers at Oxford, April, 1925.

latter materials we have to expect errors, and make allowances for them, but in agricultural work, simply because we are dealing with living organisms, we have to expect much wider margins of error and take precautions to deal with them.

This error is inherent in all our work, and conclusions can only be reached from our experiments by submitting our results to a more or less statistical review. We want to get, as it were, the statistical frame of mind, and when I say that I mean something of this kind. We say, for instance, that men are taller than women. Well, that is true, statistically, but it has nothing to do with the fact that a particular man—any odd man you may meet in the street at any odd moment—may not be so tall as the next woman you meet. You have to take a certain number or " sample " of men and a " sample " of women, and these samples must be fairly large and taken without any bias, before you can verify the conclusion that men are taller than women. There is no certainty about particular instances, and, moreover, you may easily deceive yourself if the sample upon which you try to found your conclusion is not a true sample but badly selected. That is the kind of view which we have always to take into account, that before you arrive at your conclusion where material varies you have to make sure that you are reviewing a big enough sample and an honest one.

Casual Error.—Now let me come back to the important point of the question of the yields from plots. I can best illustrate my point by an examination of the records of some of our oldest experiments, the Rothamsted experiments. We may take a couple of plots on the barley field, plots that are fully manured, the only difference being that one has nitrate of soda and the other sulphate of ammonia. Now it happens that on the particular Rothamsted soil, on that particular field (well supplied with carbonate of lime) and for the barley crop these two sources of fertility are practically equivalent to one another. If we take the average results of those two plots in comparison with one another over the period of 70 years we shall find that the superiority of the nitrate of soda plot over the sulphate of ammonia plot is only in the order of 1 per cent. It is no more than just perceptible. Suppose, however, that we look at the individual years, we then begin to find that the yields from these plots are very irregular. There are times when one plot is better than the other, and sometimes the reverse. One method of comparison is to take the mean of the yields of the two plots and express the yields of one or other in individual

years as percentages of those means. Well, if I take the very first three years I find the yields differ as follows:—

Plot 1.	*Plot* 2.
95	105
92½	107½
99	101

There are these great differences at the outset between plots whose average yields are practically identical. Other years in which there were great differences between the two plots gave the following comparisons:—

Plot 1.	*Plot* 2.
89	111
112	88
97	113

This phenomenon may be traced through all the Rothamsted experiments in which the same treatment is repeated year after year, upon the same land, and where the very greatest care has been taken to avoid mechanical errors. In the case of the grass plots you may find in any year that a plot may vary by 20 per cent. from the position you would expect it to occupy relative to the others. You must take that as a general phenomenon attaching to the very nature of the work which we are trying to do. You might, of course, look very intimately into the circumstances of any particular year and you might perhaps find some reason for the abnormality—some effect of weather, subsoil, disease, etc., which was reflected on one plot and not on the other. These variables are so numerous and so irregular in their action that you can only give a probability that a certain result will be obtained in a particular year.

Suppose we look at another type of experiment. I would ask you to study rather carefully some figures which were set out in the "Journal of Agricultural Science" about 1911. About that time two papers were published, one by Professor Wood and Mr. Stratton* and one by Mr. Mercer and myself,† both of which attack the same problem but from a rather different angle. The plan we adopted was to take a normal, fairly uniform, crop sown on a uniform field in the ordinary way of business, and to divide that crop up into a series of plots. We weighed the yield of each of those plots with as great accuracy as we could. Two of the experiments dealt with the growth of mangolds, and one with wheat (at Rothamsted). The mangold field was divided into two-hundredths of an acre, and the roots and leaves were weighed separately. In the case of wheat an acre was divided into 500 separate plots. The grain from

* Vol. III, Pt. IV., December, 1910, p. 417.
† Vol. IV, Pt. II., October, 1911, p. 107.

each plot was thrashed out and the grain and the straw were weighed separately. The average weight of the mangold crop in the 1/200th acre plot was of the order of 360 to 370 lb., but we got a weight as high in one case as 384 lb. and as low in another case as 267 lb. The variation in yields may be illustrated by the following weights of adjoining plots "across" the field: 376, 371, 355, 356, 335, 332 lb., and the following weights of adjoining plots "down" the field: 376, 316, 326, 317, 321, 335, 341 lb. A close examination of the trend of the weights did show that the yields might be a little better on one side of the field than the other, but there was no great difference from top to bottom of the field. There was irregular variability which could not be assigned to any cause. A little group of plots gave yields of 324, 316, 342, 300, 286, 330, 317, 295, 308 lb. In close juxtaposition yields as high as 342 and as low as 286 lb. were obtained. The same results were obtained from still smaller plots on the wheat field. The variation in these cases was as follows. The average weight of grain per plot was about 4 lb., but individual yields as high as 5.16 lb. and as low as 2.73 lb. were obtained. These were variations of 30 per cent. on either side of the average.

The objection may be raised that variations of the kind were to be expected in dealing with that acre of land, or that errors were introduced as a result of the small size of the plots. There was nothing to indicate in the look of the fields that they were irregular. The areas in both cases were picked out as seeming by eye to be very uniform. I would like to digress here to ask if you have ever tried to consider what kind of differences in crops you can estimate by eye. We had a very good chance of testing this point at Rothamsted. We made a practice of asking farmers well accustomed to judge to estimate the differences in yields between plots on the Little Hoos field and of comparing these estimates later with the actual yields. As a result we came to the conclusion that it was practically impossible to detect by eye differences of less than 20 per cent. in yields. Only differences of this order came to the eye, so that when a difference of 5 per cent. was estimated by the eye, it was actually 25 per cent. It is very difficult to detect differences in root crops, because a small difference in diameter makes a large difference in weight of root. Psychologists have told me that it is a general law that if by your judgment alone you are going to sort out things into a series of classes you cannot make more than five such classes, *e.g.*, very good, good, middling, bad, very bad.

Now let us come back to the mangold and wheat plots. We wanted to see if there was any fundamental source of error affecting the results, that is whether the variations were of a "normal" or an "abnormal" character. Now we might take another set of numbers instead of these results. Suppose you want to find the kind of variation in the weight of something that grows naturally? We used to speak of the weight of a barley corn as a unit of weight, but if you examine a thousand barley grains you find the same kind of variation of which I am speaking, you get a lot of grain falling about the mean in weight, but a few varying widely from the "legal" barley grain in weight. How should we proceed to examine this variation? This first thing is to throw your material into a curve, and see how far that curve agrees with the "normal curve of error." You must classify your figures into groups. We can class the mangold weights into groups by every 10 lb. Our lowest weight was about 280 lb. We find the numbers of results falling into the groups 280-289 lb., 290-299 lb., etc., and plot a curve of the results in the following way.

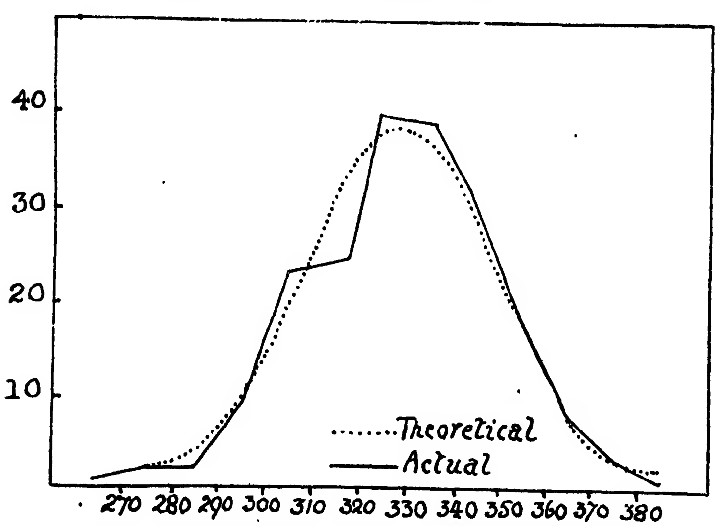

FIG. 1.—Frequency curve for 200 Plots of Mangold roots; actual and theoretical.

This curve approximates closely to the normal curve of error or frequency curve which is shown in the above figure by a dotted line.

A curve approximating to this shape at once gives us the information that we are dealing with uniform material, that our

sample is a proper one and that our variations are casual. You may sometimes find your curve not one of this description. You may find that the curve is not symmetrical on both sides of the apex, in which case your material is not homogenous or you may get two peaks, which shows mixed material, the curve being the resultant of two curves, each with peaks of its own. In the case of the mangold and wheat plots we were therefore able to satisfy ourselves that we were dealing with quite uniform material. You can find just the same kind of thing if you take a very large number of beans and sort them out by weights. With such material, if you tabulate deviations from the mean they will always fall into a curve of this description. This is a test that your material is uniform.

Method of Finding Probable Error.—Now how are we to get at truth in our experimental work? We cannot have in our ordinary experimental work 200 or 500 plots. We have to know how small a number it is safe to deal with. We therefore apply a further test to our experiment. We ought to be able to calculate out our expectancies, our belief, in the results. We know results are subject to error, but how big is that error likely to be? Mathematicians have adopted a method by which the probable error can be calculated when there are a number of experiments. The actual process is a very simple one: find the mean of results, find the difference of each result from the mean; square each difference; add the squares of the differences; divide by one less than the number of results: find the square root of that result; and that gives what is called the "standard deviation." Two-thirds (or .6745) of that standard deviation gives what we call the "probable error." By the probable error we mean that it is even betting whether any result falls inside or outside the probable error on either side of the mean. That is the treatment which every scientific man doing experiments wants to arrive at. Suppose in a comparison of Yeoman wheat with Squarehead's Master in a 10 plot experiment the mean yield of Yeoman was (say) 103.4 per cent. of that of Squarehead's Master, with a probable error of 2 per cent. This would mean that it is even betting that the real difference between the two is something more than 1.4 per cent. and something less than 5.4 per cent. The difference per cent. between the two is less than twice the probable error. That means that we must not bet on our results. We want to get the probability of our result large enough to make it safe to trust it. We can accept our results when our difference is at

least three times the probable error. Even this, of course, is not a certainty.

Let us come back to a consideration of our plots. We find, on examination, that we must expect differences of at least 10 per cent. and possibly 20 per cent. between plots that should be alike. We have to keep this at the back of our minds when we are designing our experiments, and when we are interpreting them. It is no good designing an experiment if the expected differences are less than the probable error. If the probable error is of the order of 10 per cent. then it is useless to put down an experiment to show that the superiority of A over B is 10 per cent. or not much over. Now in a great number of our agricultural experiments we cannot expect a 10 per cent. difference of yield. We are all familiar with the hundreds of experiments up and down the country, designed to compare the relative values of sulphate of ammonia and nitrate of soda as fertilisers. What good is there in putting down two such plots side by side when we know that the largest difference that we can expect in the results is only of the same magnitude as the error that we must expect in such plots? In the same way, suppose we are dealing with cereals, and are going to try to compare some of the well-known varieties; we do not expect very large differences between varieties—they do not exist. A 10 per cent. superiority of one over another is rather an outstanding difference. It will probably be more like 5 per cent. or 3 per cent. A pair of plots side by side is much too coarse a measuring machine to measure such a superiority. The casual variability is necessarily greater and no amount of skill and care on our part can reduce or obliterate it.

That is the kind of statistical idea which I think every organiser, every experimenter, has got to have at the back of his mind. He must have, first of all, in designing an experiment, an idea what degree of accuracy will be required, and next how to design his experiment so as to measure to this degree of accuracy. Plots, however, can be useful for demonstration purposes when they are of no value as measures, and we must be clear at the outset which of the two purposes they are going to serve. In designing your experiment do not ask your experimental plots a question which is too subtle. In presenting your results give an indication of the degree of confidence that can be attached to them. You do not want to tell the farmer about probable errors, but you must give him the odds on or the odds against these results being true and worth adopting in his own practice.

Uniformity of Material—Variety Tests.—I now turn to other pitfalls in experimental work. It is necessary to inquire into the uniformity of material and the origin of material, especially that used in variety tests. You may be putting down plots to compare varieties of wheat or of barley. Now the place of the origin of the seed, and the conditions under which it was harvested, make a good deal of difference to the yield, and if we are going to get our variety trials sound we have not to send for seed to a seedsman and trust to it being reasonably uniform material. We must really make an effort to see that we are getting the same stocks on all our plots, grown and harvested under the same conditions the previous year. Again, when we are dealing with variety tests we have to be extraordinarily careful that the varieties agree with the names under which we are testing. I remember barley trials in particular where the varieties were wrongly named. This caution is much needed now that trials with market-garden crops are beginning to become general. Different seedsmen give the same name to entirely different stocks. Variety testing will have to be carried out in more specialised fashion in future than in the past. Some of us have tried to tabulate the results of county and college experiments with varieties, but the mass of results examined have never seemed to lend themselves to such treatment. We came to the conclusion that the great mass of the work, while useful as demonstrations, had no value whatever as measures.

So impressed have we been of late by the fact that the ordinary plot experiment that we can put down at a farm, or even at a college or institute farm, is subject to so large an experimental error that we are setting up some six centres where we will really get very elaborate and careful measures of the standard English varieties of our farm crops. The experimental methods at these centres will be fully dealt with by Mr. W. H. Parker later on during this Conference. I may say, however, that a special drill is divided into two so that it sows two varieties side by side. The drill turns back at the end of the row so that the rows across the field are A, B, B, A, A, B, B, etc. Everybody knows that in experimental plots the outside plants are taller than those inside, because they have more space, air and water, and so forth. In these experimental plots, therefore, the outside rows are disregarded, and only the centre ones measured. In this way we can hope to reduce the experimental error to something in the order of between 1 and 2 per cent. That is to say that for that particular soil and for that season, the

two varieties can be compared with an accuracy of between 1 per cent. and 2 per cent. Well, we hope to carry on the experiments with particular varieties for at least three seasons at each of the six stations, and to set out the relative merits of the varieties with an accuracy of 1 per cent. When it has been shown that a new barley or wheat variety has a valid claim to be, we will say, 10 per cent. better than another variety, I trust that agricultural organisers will carry on the work by organising a complementary system of demonstrations. As regards demonstrations it is not worth while putting farmers to the trouble of carrying out strip or plot work; the demonstrations should be on half fields. These are much more impressive to the farmer; and points such as differences in standing capacity are brought out much better.

In all this work the Ministry appeals very strongly for the utmost co-operation between research stations, advisory officers and agricultural organisers. This is an example of the cooperation we hope to get between all branches of the research, advisory, and educational service. The agricultural organiser cannot ask the farmer to do the measurement work; this can be done by headquarters, and the organiser can pick up the results and ask farmers to do large scale demonstrations.

I conclude by reiterating that we must not expect to get absolute truth; what we can do is to collect sufficient particulars to be able to arrive at a result which is true as a whole though it may be contradicted by parts of the whole.

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THE USE OF ARABLE LAND FOR STOCK KEEPING.

JAS. C. BROWN, P.A.S.I.,

Late Vice-principal of the Harper Adams Agricultural College.

SINCE 1920 the arable land of England and Wales has shrunk by something over a million acres, the greater part of which has been added to the area under grass, in which state it can only, in agriculture, be employed in the maintenance of stock. As average land in grass has much less stock-carrying capacity than land under the plough there seems to be a good case for using, to a greater extent, arable land for the purpose of stock keeping than is the present practice. Grassland mown for hay is one of the least productive departments of present day farming; its average yield is approximately one ton of hay per acre and it extends to one-third of the total area in permanent grass. Much

of this could be replaced by the produce of arable land at no higher cost per nutrient unit than that of permanent grass hay. Cost accounts show that, where yields in the neighbourhood of one ton per acre are obtained, the cost is about the same as that of suitable arable crops, but where two tons of hay are obtained the advantage is considerably in favour of the grassland.

Comparison of Arable and Hay Land for Stock.—The following figures are taken from the cost accounts of Mr. E. D. Simons's farm and apply to very unfavourable circumstances of soil condition and situation, especially as regards the marrow-stem kale crop, which nevertheless yielded, over a field of 16 acres, 30 tons per acre. One acre yielded 43 tons but the remainder of the crop was not so heavy. It may be remarked that the crop was cultivated on a different plan to that usually employed in growing the root crop in order to take full advantage of the more hardy character of the plant. It is one of the peculiarities of the crop that it is adapted to practically any type of soil if well drained.

Cost of growing 16 acres of marrow-stem kale; estimated total yield 480 tons.

	£	s.	d.
Manual labour	107	0	0
Horse labour	84	0	0
Artificial manures	56	0	0
Seeds	10	0	0
Rent and rates	32	0	0
Depreciation of implements ...	7	0	0
	£296	0	0

Average cost per acre £18 10s.

The cost per lb. of starch equivalent when kale is taken to contain 8.8 lb. per 100 lb. is 0.75d.

The cost per acre of growing the mixed grain crop was as follows:—

	£	s.	d.
Manual labour	2	2	0
Horse labour	2	4	0
Artificial manure	0	15	0
Seed	2	1	0
Rent and rates	2	0	0
Depreciation of implements	0	8	0
	£9	10	0

For 25 cwt. of grain made up of 12½ cwt. of peas and beans, 6½ cwt. of barley, 6 cwt. of oats and 35 cwt. of mixed straw the cost per lb. of starch equivalent is 0.86d.

The cost of growing the mixed crop on a lighter soil was £7 17s. 2d. per acre and of a similar crop on light soil and cut green at the Leeds University £5 18s. 7d. This last figure does not include harvesting.

The cost per acre of the hay crop was :—

	£	s.	d.
Manual labour	1	0	0
Horse labour	0	9	4
Rent and rates	1	17	4
General expenses	0	0	4
Depreciation of implements	0	8	0
	£3	15	0

Assuming a 25 cwt. crop, and the aftermath and winter grazing to have a value equal to $\frac{1}{3}$ of the hay crop the cost per lb. of starch equivalent is 0.8d.

One acre of marrow-stem kale—30 tons—yielded 5,913 lb. starch equivalent. One acre of mixed grain—3 tons—yielded 2,644 lb. starch equivalent. One acre of hay and grazing—$1\frac{3}{8}$ tons—yielded 1,120 lb. starch equivalent.

Thus, theoretically, the kale provided maintenance for one average dairy cow for 844 days, the grain mixture for 377 days, and the hay and grazing for 160 days.

As regards pasture land, if rent, rates, taxes, manures and cultivation be taken at £2 10s. per acre for land pastured, and if two acres of such land be required to maintain one dairy cow giving two gallons of milk daily for 26 weeks, the cost per lb. of starch equivalent obtained from grazed land is 0.6d.

In addition to the greater quantity of fodder obtained there is also some advantage not shown by accounts in keeping land under the plough, in view of the variety of produce it enables the farmer to market. Grass gives stock products only. At a time when it is necessary to produce food for stock at the lowest possible cost it may be of use to examine what class of arable farming, if any, can compare in cost of production of food for stock with average grass, which has recently been under the plough. It may be accepted that the only department of arable farming which is as effective in this respect through the summer period as pastured permanent grass is the temporary ley, because of the labour involved in all other methods of feeding stock from arable land. There are, however, only about 14 weeks of really effective grazing in the year, except in specially favoured circumstances. The

writer is not aware that any figures are available showing the output of grassland month by month throughout the year, but obviously on average land, after midsummer, yield falls off rapidly. Much grassland is occupied in the bare maintenance of life or in adding very little to the weight of animals grazing on it. The progress of stock at this time can be maintained by supplementing the grass by fodder grown on arable land, but this, of course, adds to the cost of summering such stock and it is not possible to say without comparative tests whether the increased gain is sufficient to cover the cost of the extra food supplied. When it is a matter of maintaining the largest possible head of stock a succession of arable crops with double cropping gives the best results, but owing to the heavy labour bill involved, this system in its completeness, cannot be practised profitably, under average conditions, at the present time. Only under favourable conditions will the returns be sufficiently good to cover the greatly increased expenditure of handling by manual labour the whole of the food required by stock. Experience has shown that, under present conditions any successful system of arable stock farming must include a grazing period to cover the most productive period of the summer months.

Temporary grass has been very successfully used for grazing in the North of England. Temporary grass is generally believed to be less valuable for grazing purposes than permanent grass, but no definite information exists to show that this is so, and the writer has often observed that cattle having a choice of the two kinds have preferred the newer pasture. From the farmer's point of view temporary pasture has an attraction, in that when heavily stocked it is being brought to a high pitch of fertility suitable for the growing of profitable crops of cereals, whereas fertility may accumulate in old pasture and have little immediate value. With the recent rise in the price of corn and feeding stuffs it is open to question whether the present tendency to return land to grass is likely to be more profitable than a change of practice in the management of plough-land aiming at supporting a larger head of stock, and at the same time, providing concentrated feeding stuffs on the farm and also some grain for sale. Experience has shown that the labour on stock and the cost of feeding must not greatly exceed that of the grass farm if a profit is to be reached at present prices.

Cost accounts have shown, however, that under extremely adverse conditions when arable land is suitably and economically

cropped nutrients can be produced as cheaply as on average permanent grass mown for hay. Recent experiments on an extended scale show that several arable crops can be used effectively in the place of hay, and from three to five times the quantity of starch equivalent produced per acre at no greater cost per unit. For winter feeding the produce of arable land is as economical as that of average grass. There remains the further possibility of increasing the efficiency of the farm by supplementing the produce of the pastures from the arable land after the flush of grass is over. By this method the early summer rate of increase can be maintained. It is possible that silage may be the best food for this purpose, and it remains to be shown by actual comparison with grazing whether ensilage can be made profitable, but throughout the whole country it is obvious that much time is lost by stock remaining almost stationary in growth during late summer and autumn.

Crops for Stock Feeding on Arable Land.—(1) *Marrow-Stem Kale.*—Practically every crop suitable for stock feeding has been tried in the writer's experiments, and the following stand out as the most reliable and suitable for the purpose. Marrow-stem kale is placed first because no other crop that can be grown in England will produce so much nutrient matter per acre, few crops are so reliable and none more relished by cattle or sheep. It has many advantages over the popular root crop. In the first place the labour on the crop need not be more than half that required for roots. The plant contains much more protein and lime than the root crops, and its response to generous manurial treatment is more sure. This crop is best grown on the kale garden plan, continuously on the same land, which has been raised to the highest possible pitch of fertility. It is of course essential that such land be well supplied with lime and mineral manures in addition to all the farmyard manure which can be spared for the crop. If well drained, almost any land will, treated in this manner, give heavy crops. It is much easier to grow 40 tons per acre of this crop than of any other available to the British farmer, and it pays to treat it well because it never fails to respond.

The crop can be obtained forward enough to feed in October and is useful until the end of February or later. It is so variable in type, however, that by selection and hybridisation the period of usefulness could be extended to cover the whole year if necessary; its possibilities remain largely unrealised. Its

winter hardiness has, however, been much improved since its introduction.' Marrow-stem kale is more nearly a balanced food than roots, and can be successfully fed in larger quantities than it is advisable to feed roots. Whether, however, it is better practice to give smaller quantities and to balance the ration with concentrated foods is a matter of opinion. It seems mainly a matter of which gives the cheaper supply of nutrients. By crossing this plant with perennial forms of kale the writer is of opinion that by such means the ideal crop for supplementing pasture in the late summer months could be obtained.

(2) *Mixed Corn.*—Next to marrow-stem kale in usefulness is a mixture of beans, peas, barley and oats, which stands out superior to any other arable crop in its reliability and the ease with which it can be grown. It has a wide range of adaptability to soil conditions and can be grown with success even on light soils if farmyard manure and phosphates be supplied. The mixture was first grown by the writer for feeding green, for which purpose it is excellent, but it may also be made into silage or harvested as a corn crop, in which form it is of the greatest use in stock feeding. When grain was cheap the whole crop was cut into chaff and fed with marrow-stem kale: this plan saved the cost of thrashing but was obviously wasteful, though less so than might be imagined. The best way to use it is to thrash the crop and grind the grain to meal and feed the straw long in conjunction with marrow-stem kale, a very satisfactory ration being 50 lb. marrow-stem kale, 12 lb. mixed straw, and 2½ lb. meal of the mixed grain. Unfortunately, the seed mixture as given above cannot, without risk, be sown earlier than 1st November. If sown in September or October vetches must be substituted for peas. So far the writer has not discovered a variety of peas which, when sown early in the autumn, will withstand severe winter conditions, although a few plants will always survive. Winter varieties were known in the past but seem to have been lost, which is to be regretted as autumn-sown peas are much less subject to failure in excessively dry or wet summers than those spring sown. In the writer's experience Leighton Early winter pea has stood the winter best, and there can be no doubt that the winter-hardy character could be recovered, and also varieties could be raised which would be much better suited than the present field peas to forage cropping purposes. Probably something could be added to the rate of gain of

stock by increasing the proportion of leguminous plants in their bulk food in view of the greater quantity of lime salts carried by these plants in comparison with other species. For the months October to February the kale and mixed-crop fodder mentioned above probably forms the cheapest effective winter feed available. It is probably a good deal cheaper than silage and at least equal in effectiveness, but in our uncertain climate the drying of the grain is a consideration. When grown continuously on the same land the grain mixture crop has much the same effect on the soil as a temporary ley and forms a good preparation for a wheat crop. The chief reason why cereals cannot be successfully grown continuously on the same land is that they destroy the texture of the soil: mixtures of grain containing peas and vetches, mellow and pulverise the soil. It is necessary to see that the soil is well stocked with potash and phosphatic manures and lime when the above crop is grown continuously. The possibility of growing a grain crop continuously on the same land without the excessive use of manures or employing a bare fallow is of considerable importance in that it offers an inexpensive plan for keeping land under the plough. It might even be possible to grow wheat continuously by mixing it with beans and peas, easily separated in the thrashing. The condition of the soil is rapidly improved by the roots of the leguminous plants, while the increase in the weight of the crop due to the mixing is quite remarkable. The writer arranged several tests of this mixture against pure cereals with manures, and while it was doubtful from observation whether the manures had any effect on the crop, the effect of the mixing was unmistakeable; the crop looked double the weight of the cereal and could not have been less than 50 per cent. heavier. Peas and beans are a traditional preparation for cereals, and their effect is equally beneficial when the plants are growing side by side.

The crops described greatly increase the stock-carrying capacity of a farm and all are inexpensive to grow and produce nutrients at as low a cost as hay from permanent grassland. There is also a further aspect of this class of cropping. England still has over 300,000 acres of bare fallow, a large part of which could be profitably cropped with the grain mixture described above. On well-drained land nearly every kind of weed can be destroyed by autumn-sown smother crops. In fact these crops have much the same effect on the land as fallowing, killing out the weeds, improving the soil texture, and rendering its condition suitable for carrying a cereal crop. The grain mixture

is specially suited to land on which bare fallow still forms part of the usual practice. Success in obtaining a smothering condition depends on getting a dense plant early on the ground: deep ploughing is the first step, accompanied by generous manuring; then early autumn sowing as soon as possible after ploughing and the inclusion of vetches in the mixture if the land be very weedy. Where the land is comparatively clean to commence with it will easily maintain its condition when cropped continuously with the mixed grain crop.

Cultivation of Mixed Corn.—The mixed crop differs from the pure cereal crop in that the leguminous part of it fills up the spaces between the upright cereal plants and prevents light and air reaching the ground: the mixture of leguminous and cereal plants more closely resembles the natural herbage of a pasture, while the soil condition remaining when the crop is removed is quite different from that left by a pure cereal crop. In a recent test, in which three successive crops of the mixture were grown on land choked with perennial weeds, the only perennial weed not destroyed was the dock, which owing to large reserves of food material, held in the root, is able to survive and overtop even the densest crop.

The crop can be sown at any time from October to March; under most conditions it succeeds much better sown in the autumn. If sown before 1st November the seed mixture should be composed of 2 bus. beans, ½ bus. vetches, 1 bus. winter barley, 1 bus. winter oats per acre. If sown later than this date it should be made up of 2 bus. beans, 1½ bus. field peas, 1½ bus. winter barley and 1 bus. winter oats, sown at the rate of 4 bus. per acre. The quantity of seed required depends on the character of the land—in some cases it may be reduced to 3 bushels, while on some of the poorer soils it is advisable to increase the seeding to 5 bushels. It has always been the writer's practice to sow the mixed seed on the raw furrow and to cover the seed with the spring-tined harrow, giving no further cultivation. On light soils it is possible that rolling might also be needed. A dressing of 5 cwt. to 8 cwt. of basic slag and 2 cwt. of kainit seems to be the most suitable manurial treatment. On light soils the crop is greatly benefited by dressings of farmyard manure, but on the heavier soils artificial manures alone will give full crops. One of the chief uses is the smother effect of the crop, which depends on a full growth being obtained, so that the necessary manure should not be withheld.

The method of ploughing the land is of great importance in securing the destruction of weeds. On heavy soils deep

ploughing is necessary to get good results. It will be seen on examination that the roots of perennial weeds exist mainly in the surface five inches of the soil. By ploughing deeply and using a large skim coulter the greater part of the roots of the weeds can be buried and several inches of soil free from weeds got up to the surface. In this soil the seed of the crop can establish itself in advance of the buried weeds. If it fails to do so the smothering will be incomplete. The beans and peas grow away in advance of the cereal portion of the crop and flower, and form pods before being covered over by the grain crop: thus the density of the mixed crop does not interfere with seed development. Also, the mixture appears to be less liable to insect and fungus attack than either of the crops grown separately.

Other crops can be employed where the land is suitable; thus rye can be used as a hay crop and followed by turnips. It is not generally known that rye, when cut very early, makes a very nutritious hay of which stock are particularly fond. A mixture of wheat and peas, autumn sown and cut when the peas are in flower, makes excellent hay, as also does a mixture of vetches and winter oats autumn sown. Where land is not subject to frit fly a mixture of peas and oats is the best crop for sowing in the spring to harvest as a hay crop. If it is intended to harvest for seed, beans must be included in the mixture as otherwise the crop will, if heavy, be very liable to become laid before it is sufficiently ripe to cut. The hay from the mixtures named is not more difficult to make than seeds hay, but requires time in the field. It used to be the writer's view that it was the best plan to put the mixture early into large cocks, but there certainly is a case for leaving it in rows and turning each day whether dry or wet. The grain mixture has in most cases many advantages over the other crops described. The almost complete absence of risk in growing this crop, and the many uses to which it can be put, render it best suited to compete with grassland at the present time, and there are few farms where it could not be tried with advantage. Instead of seeding more land down to grass the following rotation is suggested, which, so far as the experiment has gone, the writer has found successful on an intractable soil.

1, 2, 3, 4—beans, peas, barley and oats' mixture; 5—wheat; 6—oats; 7—clover; 8—wheat.

This arrangement gives seven-eighths of the land under corn with greater certainty of securing a heavy crop of clover hay or

forage in the remaining year. The grain mixture crop is a good preparation for wheat, especially so if the crop be cut green. The green forage required is kept out of this rotation, being grown separately as previously described, so that the grain does not have to carry part of the loss on the root crop as in the case of the four-course rotation.

To carry out the above scheme about one-third of the area of the farm is needed in grass, either temporary or permanent, but the most suitable proportion will be determined to some extent by the character of the farm concerned.

The above scheme can be applied to much of the land which is being laid down to grass, and as the unprofitable root crop is eliminated and high yields of mixed corn can be obtained, while the condition of the land is improved and no bare fallow is required, in many cases land should give a more profitable return than from grass. The success of arable stock farming in England depends on the production of nutrients at as low a cost as they can be provided by grass and in converting them into meat or milk as cheaply. The necessity of keeping costs down to this level makes it impossible to intensify stock farming up to the full limit of what the land can carry, but it would appear that given a suitable system there is no reason to suppose that grass is the only solution to the present-day problem with which the land is faced.

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LIVING CONDITIONS OF HOP-PICKERS IN KENT.

AT a recent meeting of the Council of Agriculture, the Ministry was urged to take some action with a view to the improvement of the conditions of employment of women and child labour on the land. As a first step, after consultation with the Ministry of Health, it was decided that it would be of advantage to draw attention to the conditions of employment in the Kent hop-fields. It is hoped that hop growers will co-operate with local authorities in securing a reasonable standard of decency and comfort for the temporary workers employed in the hop-picking season.

An instructive account of the lodging and accommodation of hop-pickers and pickers of fruit and vegetables was prepared in 1907 by Dr. Reginald Farrar, one of the Medical Inspectors of the Ministry of Health, and Dr. Farrar's report still remains the standard work on the subject.

The report pointed out that there was a tendency for the smaller farmer to be squeezed out by the bigger grower, and that the crowding out of the small farmer had a bearing on the labour conditions since, while the small employers can often not afford adequate provision, the big employers " regard, or should regard, such provision as part of their capital outlay."

Dr. Farrar classified hop-pickers as " home " (*i.e.*, local pickers), " foreign " (*i.e.*, " imported ") pickers, gipsies and casual vagrants He estimated that no fewer than 100,000 " foreign " pickers and " half " pickers, in addition to younger children to the number of probably not less than 50,000, migrate into the hop-growing counties during the hop harvest. He drew attention to the congestion of casual wards during the first and final weeks of the hop-picking season, since the poorer hop-pickers treat them as houses of call *en route* to and from the hop districts. Dr. Farrar describes some of the better types of housing provision, and concludes by saying that, while " the accommodation provided for hop-pickers affords ground for serious complaint in particular instances it is only fair to record that this accommodation is not, on the whole, generally unsatisfactory." He adds, however, that " bye-laws should be adopted in any district in which hops are grown on an extensive scale, and that the Board's model bye-laws represent the minimum standard in respect of health, decency and comfort for hop-pickers."

Many changes have taken place since the date of the above report, and the area under cultivation is now not much more than one-half what it was in 1907. Picking is, however, still mainly done by hand, and there are as yet few indications that picking or stripping by machinery is likely to be generally adopted in the near future. So, for the short period (normally one month) that hop-picking lasts, a considerable volume of labour is still needed, and the fact must be faced that it is likely to be less easy in the future to obtain suitable labour than it has been in the past. The tendency of present-day legislation is to curtail the employment of child labour and to " de-casualise " adult labour, so that in order to attract the workers required not only improved wages but improved conditions while at work are necessary both in the interests of the employer and the worker.

Following these preliminary remarks, a short account may be given of the hop-picking conditions prevailing in Kent at the present time.

There is, of course, considerable variation in the size of hop gardens in the county. There are a number of small hop gardens on the outskirts of towns employing purely local labour to the number of 100 or so. Here practically no difficulties arise since the employees are within easy reach of home. Such work is particularly prized by the married women who are able, with the assistance of their children, at little practical inconvenience to themselves to supplement the family income. The larger gardens, employing anything up to 1,000 pickers, also in some cases depend on local labour but draw it from a greater distance: the remainder depend on " imported labour," the real problem of Kent. Accurate figures are hard to come by, but it is generally agreed that upwards of 70,000 people (chiefly women and children) migrate annually from London into the Kentish hopfields. This is a serious matter from every point of view. It not only affects the grower and the worker, but has reactions on local life. And, though the duration of the invasion is limited, the fact that it is of yearly occurrence makes it of importance and justifies the growing demand for more effective regulation.

The same labour is normally engaged by the growers year after year, and the engagement is effected directly or through an agent of the farmers. In the past, transport has also been arranged individually, but the establishment of the Mid-Kent Hop-pickers' Welfare Committee, some two years ago, has already effected appreciable changes in this direction. With the co-operation of growers, workers, and the railway company, a system is being evolved which will permit of the workers being brought on the scene at the required moment and with the minimum inconvenience to themselves. The congestion of workhouses, of which Dr. Farrar complained, should, therefore, no longer occur, and the overcrowding, the delays, the unsuitable hours of departure and return, which resulted in much inconvenience to " the hoppers " will, it is hoped, shortly be past history. Minor transport troubles are yet to be finally solved, including in some cases, the conveyance of workers from the station to the farm, but a great improvement has already been effected, to the relief of all concerned, including residents in the locality.

The question of accommodation for the "Londoners" remains, however, the concern of the individual farmer, and there are very great variations of standard. Some admirable arrangements can be seen in the case of certain large growers. Well laid-out camping grounds, with wooden huts partitioned into

sections or cubicles, are a feature of such places. Drinking water and earth sanitation are provided. There are common cook-houses and facilities for procuring food. Medical assistance is available, and all the requirements of a well-conducted camp are met. Correspondingly good arrangements are made by many smaller growers.

But it remains true that these are the exception rather than the rule. In view of the general advance in social conditions, the prevailing standard leaves much to be desired. Dirty and untidy camps, with overcrowded huts, with deficient or unsuitable sanitary provision, and with unsatisfactory cook-houses are still far too common. On the other hand drinking water is now more generally available than was formerly the case. When every allowance is made for difficulties created by the pickers themselves it remains true that the *average* accommodation provided for them has not kept pace with the time and falls short of those minimum requirements which may be reasonably required for such temporary housing.

Where *imported* labour is concerned and where housing has to be provided in large barracks and encampments, experience suggests:—

(*a*) that the number of residents should bear some definite relation to the amount of floor space and cubic space in sleeping compartments;

(*b*) that water for drinking and cooking purposes should always be available;

(*c*) that sanitary and ablution huts should be included in the compound, and definite arrangements be made for their cleanly maintenance;

(*d*) that cook-houses should be provided;

(*e*) that premises should be repaired and disinfected between seasons;

(*f*) that the owner should be required to provide the services of a camp superintendent;

(*g*) that where no suitable voluntary organisation exists there should be some call on the services of a local doctor or nurse, or both;

(*h*) that pickers should be encouraged to assist in preventing overcrowding and maintaining cleanly conditions.

Local authorities have it in their power to do a good deal to assist in this matter. The legal position is that by the Public Health Act of 1875 and the Public Health (Fruit Pickers' Lodgings) Act of 1882, local authorities are empowered to regulate the action of those *providing* accommodation by making

bye-laws for securing the decent lodging of persons engaged in the picking of fruit, vegetables and hops. They also have power to regulate the action of those *occupying* such accommodation by making bye-laws under Section 9 of the Housing of the Working Classes Act of 1885. The Ministry of Health has drawn up model bye-laws for the guidance of local authorities, and it is understood that these bye-laws are under revision at the present time. A number of local authorities have made bye-laws, but the difficulty is that, even when made, they are often inadequately enforced.

The question from a legal point of view is essentially a matter for the local authorities concerned, but from a practical point of view it is well deserving of consideration by the employers. Points which were particularly noticeable last year were the failure to cleanse the camps before the pickers arrived, and the neglect of efficient scavenging during occupation. It is obviously the duty of the employer to see that the camps are kept in a reasonably sanitary condition. This can only be done efficiently by providing paid workers to undertake the work daily. Possibilities of this kind were indicated in an article on "The Housing of Casual Labour" in this *Journal*, February, 1924, p. 1017.

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ENSILAGE.—VII: THE FEEDING OF SILAGE.

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IN the previous article of this series* Dr. Woodman has described certain of the changes which occur during the conversion of a green crop into silage, and indicated how variable may be the quality of the product according to the conditions prevailing in the silo. He has also shown that the feeding value of the silage varies with the quality, that in one case the value of green fruity silage was to the acid brown type as 7 is to 5, and that sweet silage made at too high a temperature may be rendered much less digestible than if made at a lower temperature.

* "Chemistry of Silage," this *Journal*, May, 1925, p. 124.

It is a point of first importance in considering the feeding of silage to realise that it varies very greatly in quality. The green fruity type, when successfully made, undoubtedly has the best feeding value, but the conditions under which it can be made are none too well known at present and a slight misjudgment may result in the production of sour silage. Acid brown silage can be easily and surely made and is the next best in value. Sweet silage is very palatable, but like over-heated hay has become less digestible and if fed in excess may cause some scouring. Sour silage, if only slightly sour, may be good feed, or on the other hand the amount of butyric acid present may be so great that stock will refuse to eat it and men to handle it.

In addition to the quality of silage as indicated by the character of the acids produced there is another important respect in which quality varies, namely, in the variety of the crop or mixtures of crop ensiled as well as quality of the crop itself. In the silage boom during the period 1880-90 many people believed that it mattered little what was put into the silo; it would all become good silage. Nothing could be further from the truth. The character of the crop ensiled is most important.

All sorts of crops and mixtures of crops are now being ensiled, *e.g.*, grass, "seeds" mixtures, mixtures of cereals with legumes and maize, and beyond this the different degrees of maturity of the crop ensiled all have their influence upon the food value of the silage. One or two outstanding points may illustrate these influences more clearly:—rye is sometimes used in mixture with tares; this almost invariably becomes old, fibrous and indigestible before ensiling and consequently such silage is disappointing in its feeding properties; similarly, if for any reason the tares or other legumes fail to produce a fair proportion of the crop, and the oats and other cereals form the greater part of the silage, then the resulting silage is less palatable and less digestible. On the other hand it is a matter of observation, when a mixed silage of legumes including tares and beans with cereals is fed to sheep or other animals, that these pick out the leguminous portions in preference to the cereal straws. The food value of such mixed silages will, therefore, vary greatly with the relative proportions of cereal and legume, as also with the proportion of seed and fruit to leaf and straw of each constituent plant. Maize silage is very different in chemical analysis and feeding properties from the mixed cereal and legume silage, and when grown in this country the maize generally has few cobs and is rarely sufficiently

mature for correct ensiling. In view of these wide variations in crops for ensilage the further discussion of silage feeding in this article, unless otherwise stated, will refer only to mixtures of oats with the legumes, tares, peas and beans. The foregoing paragraphs have shown how widely silage may vary from the point of view of the crop materials from which it is formed. Analysis of the moisture content indicates another important variable. Oat and tare silage has been found to vary from as much as 80 per cent. of water to less than 60 per cent., and when attention is diverted from moisture content to dry content of silage it will be seen that this varies from 20 per cent. to 40 per cent.; in other words, the silage containing 80 per cent. of water contains only one half the food value of silage containing 60 per cent. of water. This is very important to bear in mind in rationing and still more important in conducting demonstration trials and experiments in feeding, especially when it is realised that the percentage of dry matter may vary greatly within a depth of a few feet in the silo. In order to define a standard in this matter, the writer has regarded silage containing 70 per cent. moisture (*i.e.*, 30 per cent. dry matter) as standard silage; and in practice it is found that the average of analyses of many samples of oat and tare silage made in the comparatively dry area of the Eastern Counties is close to this standard. In moister districts the average per cent. of moisture is probably nearer 75.

A farmer when commencing to produce and to feed silage always wants to know with what other farm crop he may compare it, and in particular how it compares with roots. He grows it as a substitute for roots: how far can he feed it as a substitute? From the analytical point of view silage is succulent; roots are succulent, containing 85 to 90 per cent. moisture and green crops are also succulent, containing generally 70 to 85 per cent. So far the comparison between roots and silage is reasonably close, but the following table giving the composition of the dry part in each of four foods shows that the similarity stops at this point.

TABLE I.—COMPOSITION OF DRY MATTER.

	Mangolds.	Green Oats and Tares.	Oat and Tare Hay.	Oat and Tare Silage.
Crude Protein	8.7	10.8	13.9	12.5
Nitrogen—free Extractives = Carbohydrates	78.0	50.2	45.8	45.6
Ether Extract = Fat, Chlorophyll, Acids	0.8	3.0	2.0	4.3
Crude Fibre	6.0	28.1	29.0	29.4
Ash	6.5	7.8	9.1	8.1

A glance at the table is sufficient to show that the food contained in oat and tare silage does not compare closely with that contained in mangold. The former contains nearly 50 per cent. more protein. Mangolds contain nearly twice as much carbohydrate as silage and, since in mangolds these are chiefly in the form of sugar, they are more easily digestible. The ether extract shows 5 times as great a quantity in silage as in mangolds; this difference is due largely to the presence of the acids in silage, the full significance of which in the food is not known. Silage contains nearly 5 times as much crude fibre as mangolds, a most important difference, since this has a large influence upon the rate of passage of the food through the bowels of the animal. Roots are generally fed to cattle in conjunction with some roughage. straw or hay, but it is not so important to feed such roughage with silage and impossible to feed it in so large a quantity. On the other hand the table shows that silage compares closely in the analysis of its dry material with the green crop from which it is made and with hay made from the same green crop. In feeding silage. therefore, it seems advisable to compare it not so much with roots as with the green crop from which it was ensiled or, except as regards succulence, with hay made from a similar crop. None the less because silage is grown in the place of roots and because the farmer is keen to know the answer to the question: " How does silage compare with roots in feeding value?" a number of useful trials have been carried out by Oldershaw in East Suffolk.* by Rae at Oaklands, Herts,† by Drew at Glasnevin,‡ and by Sheehy and Delaney at Athenry,§ which in general show that well-made silage gives as good results or perhaps slightly better than the analysis suggests.

The trials by Drew at Glasnevin are perhaps the most comprehensive of those yet published and part, at any rate, of the difficulty of designing a simple experiment for comparing foods so widely different in composition as roots and oat and tare silage has been overcome by feeding silage and some hay on one side of the experiment, against roots and extra hay on the other side; this plan serves to overcome part of the differences due to fibre-content in the two foods, but does not attempt to balance other food constituents.

* Oldershaw. Journal of Board of Agriculture. Vol. XXIII, June 1916.

† Rae. Bulletin No. 2. Herts. Institute of Agriculture.

‡ Drew. Journal of Irish Dep. of Lands and Agriculture. Vol. XXIV, No. 3:

§ Sheehy and Delaney. Journal of Irish Dep. of Lands and Agriculture, Vol. XXIV, No. 2

None the less the results are very informative, and are quoted below.

In one case 28 bullocks for fattening were divided into 4 pens and fed the following rations :—

Silage. Lot No. I.	*Roots.* Lot No. II.
30 lb. Silage.	50 lb. Roots.
3¼ „ Palm Nut Cake.	3¼ „ Palm Nut Cake.
3¼ „ Oats.	3¼ „ Oats.
17 „ Fodder.	18½ „ Fodder.
Lot No. III.	Lot No. IV.
50 lb. Silage.	84 lb. Roots.
2¼ „ Palm Nut Cake.	2¼ „ Palm Nut Cake.
2¼ „ Oats.	2¼ „ Oats.
10 „ Fodder.	19 „ Fodder.

The silage was made from a crop seeded with 12 stones of beans, 6 stones of oats, 8 stones of peas and 8 stones of tares. The roots were mangolds. In compounding the ration 6 lb. of silage were regarded as being equivalent to 10 lb. of roots, but it is significant that the dry food content of the silage is not stated. Palm nut cake and oats were fed equally to Lots I and II and to Lots III and IV and fodder was fed *ad lib.*, weighed and the amount actually consumed recorded and stated in the above rations.

The trial lasted 82 days with the results shown in the following table—

TABLE II.—LIVE WEIGHT INCREASE ON SILAGE AND MANGOLDS.

		Average Live Weight Increase.			Average Daily Increase.
		cwt.	qr.	lb.	lb.
Lot I.	Silage ...	1	3	4	2.44
„ II.	Roots ...	1	3	25	2.69
„ III.	Silage ...	1	2	4	2.09
„ IV.	Roots ...	1	1	16	1.90

Comparing Lots I and II there is a daily gain of .25 lb. in favour of mangolds, but this gain is put on at a cost of 1½ lb. of extra fodder. On the other hand in comparing Lots III and IV there is a daily increase of 0.19 lb. in favour of the silage group, though the root-fed bullocks consumed an extra 9 lb. per head per day of fodder. The suggestion of Drew that 6 lb. of silage is equivalent to 10 lb. of mangolds and some fodder is supported by these trials.

In the same publication Drew describes a similar trial with 14 dairy cows divided into two groups receiving the following rations :—

Ration I.	Ration II.
50 lb. silage	84 lb. roots
3 „ palm nut cake	3 „ palm nut cake
3 „ oats	3 „ oats
11 „ hay	14 „ hay

The rations again provide the comparison between 6 lb. of silage and 10 lb. of roots plus some hay.

The trial period lasted for two periods of 6 weeks between which the rations were changed over, allowing a transition period of 14 days to elapse whilst the cows settled down to their changed rations. Table III gives the average weight of milk and percentage of fat at different periods during the trial :—

TABLE III.—SILAGE VERSUS MANGOLDS FOR MILKING COWS AT GLASNEVIN.

		Prelim. Period.	Silage Ration.	Transition Period.	Root Ration.
Group A	Yield of Milk ...	25.8	21.7	19.2	18.7
	Percentage of Fat	4.20	4.02	—	3.87
		Prelim. Period.	Root Ration.	Transition Period.	Silage Ration.
Group B	Yield of Milk ...	25.4	21.5	19.4	19.1
	Percentage of Fat	4.22	4.24	—	4.10

The above figures show great uniformity and suggest equality of feeding value between the two rations for the production of milk, and still further support Drew in his view that 6 lb. of his silage can be used to replace 10 lb. of roots and some fodder in the rations of cattle, a view which is in general agreement with other trials and supported by farmer's experience.

Several series of experiments have been carried out at Cambridge during recent years, but these have for the most part been designed on rather a different plan in order to avoid comparing two such dissimilar foods as silage and roots. In the three winters 1920-21, 1921-22, and 1923-24 the basis of comparison has been equal dry weights of oat and tare hay with oat and tare silage made from the same crop mixture, each lot of cattle receiving in addition equal weights of straw chaff, roots and meal. As an example, in 1921-22, 16 young cattle aged 18 to 21 months, were selected from a bunch of 20 and divided as carefully as possible into two lots of 8 each. At the beginning of the experiment, 24th November, they were gradually brought on to the following rations :—

	Hay Ration.	Silage Ration.
Oat and Tare Hay	8 lb.	Oat and Tare Silage equal in dry weight to 8 lb. hay
Straw Chaff	3 „	3 „
Kohl Rabi	14 „	14 „
Bean Meal	1½ „	1½ „
Barley Meal	1½ „	1½ „

The actual weight of silage fed varied from time to time according to the percentage of dry food it contained. At the beginning of the experiment the hay contained 88.9 per cent. of dry matter and the silage 30.6. The equivalent dry weight of silage to 8 lb. of hay was therefore $8 \times \frac{88.9}{100} \times \frac{100}{30.6} = 23.2$ lb. The moisture in the silage was determined once per week and the ration recalculated after each determination. The rations were compounded and fed in such amount as the cattle should easily clear up, but as the animals grew and their appetites increased the rations were also increased. Thus on 28th December the straw chaff was increased to 4 lb. per head, and on 23rd February the hay was increased to 10 lb. on one side of the experiment and on the other side the quantity of silage was increased proportionally.

The cattle were brought to the experimental rations on 24th November and after a preliminary fortnight were weighed on 8th December, when the experiment proper commenced. The first part of the experiment lasted 63 days, until 9th February, when the cattle were weighed again. Then between 9th and 23rd February the rations were gradually reversed so that those cattle receiving hay were put upon the silage ration and vice versa. The second part of the experiment lasted 49 days until 13th April, when the cattle were weighed for the last time.

The quality of the silage fed during the experiment was good, except for a few days at the beginning of the first period when the silage had undergone a slight secondary fermentation after the silo was opened; for the greater part of the time it was of the green fruity type. The hay also, having been cured during the dry summer of 1921, was very good.

TABLE IV.—RESULTS OF FEEDING EXPERIMENT, 1921-22.

		Average Initial Weight.			Average Final Weight.			Average Increase.		Average Daily Increase.
		cwt.	qr.	lb.	cwt.	qr.	lb.	qr.	lb.	lb.
					1st Period—63 days.					
Lot I.	Silage	5	2	12	6	2	4	3	20	1.65
Lot II.	Hay	5	2	8	6	1	13	3	5	1.41
					2nd Period—49 days.					
Lot I.	Hay	6	3	6	7	1	7	2	1	1.16
Lot II.	Silage	6	2	25	7	1	20	2	23	1.61

The table shows that during both periods the cattle fed upon silage increased in weight more rapidly than those fed upon hay. In the years 1920-21 and 1923-24 similar experiments were carried out, in the former year with 12 bullocks and in the latter with 8 bullocks in each lot.

TABLE V.—FEEDING EXPERIMENTS WITH CATTLE. OAT AND TARE SILAGE VERSUS OAT AND TARE HAY WITH 56 CATTLE DURING 3 YEARS.

Year.		Duration of Period.	No. of Cattle in each Lot.	Average daily Increase. On Silage.	On Hay.
1920-21.	1st Period.	49 days	12	1.63	1.00
,,	2nd Period.	41 ,,	12	1.17	1.10
1921-22.	1st Period.	63 ,,	8	1.65	1.41
,,	2nd Period.	49 ,,	8	1.61	1.16
1923-24.	1st Period.	60 ,,	8	1.57	1.01
,,	2nd Period.	42 ,,	8	1.81	1.26
Average daily increase all periods		...	... ...	1.56	1.15

In the year 1920-21, the silage fed during the first period was of the acid brown type, but passed gradually into the sour type towards the end of the second period; this probably explains the small gain in weight of the silage cattle in this period; the oat and tare hay in 1920-21 was slightly overmature containing occasional half-formed pods with tiny seeds, not all of which were properly digested, otherwise the hay was good. In 1923-24 the silage was good throughout and varied in quality between the acid brown type at the top and the green fruity type at the bottom. The hay was good as regards maturity and stack management, but had lost some of its natural aroma by reason of a small amount of rainwash.

As shown in Table V the average gain in weight per day over all the three years' experiments for the cattle fed on silage was 1.56 lb. as compared with a daily gain of 1.15 for the cattle when fed upon hay, showing an advantage of 0.41 lb. per head per day. This in a winter feeding period of six months would mean a difference of 75 lb. per head in favour of silage.

This difference may be due in part as in 1920-21 and in 1923-24 to the inherent difficulty in making first class oat and tare hay, but it also indicates how good a food well-made oat and tare silage is for growing cattle. This is shown especially in 1921-22 when the hay was really first class. It seems fair to draw the conclusion that well-made oat and tare silage in comparison with well-made hay is worth more for feed than a comparison of their dry weights suggests, and this is borne out by Woodman's experiments upon the digestibility of the two foods. On a dry weight basis with "standard" silage containing 70 per cent. of moisture and hay containing 15 per cent. of moisture, 100 lb. of silage would be equivalent to 35 lb. of hay, so that in view of the above experiments it seems fair to assume

* Woodman. J. of Agric. Science. Vol XII, Part II.

that 100 lb. of good silage may be equivalent in food value to between 35 and 50 lb. of hay according to the quality of each.

Special Uses of Silage as Food of Stock.—(1) Some foods, as for example mangolds and hay, require to be kept for a certain time before they are fit for consumption, while roots can only be kept a limited time. The fermentation changes in silage are completed very rapidly and silage is fit to feed within 10 days of making. In the summer of 1924 two 9-months old steer calves were fed continuously with 20 lb. of silage per head per day from 16th July, when a small silo was filled with oat and tare silage, until 3rd August, when fermentation was quite complete and the heat had passed off, without suffering any ill-effects and appeared to thrive upon it. Such quick feeding, of course, requires further trial before general adoption, but in any case silage can be safely fed within 10 days of making. On the other hand silage can be kept indefinitely without suffering loss of food value, and several cases have been recorded of its being kept in tower silos for 3 and even 5 years without deterioration, beyond the moulding of any part exposed to the air.

(2) Silage, when once it is made in the tower silo, is ready to feed without any other preparation than being thrown out of the silo and put into the mangers. The labour of feeding as compared with root feeding is much reduced, and in practice one man can attend to double the head of stock fed largely upon silage as compared with others fed upon a heavy root ration.

(3) Stock fed upon silage generally present a healthier appearance with more bloom on their coats than when fed upon other foods. An interesting incident in this connection occurred in the feeding experiments of 1921-22 when for purposes of keeping account of the cost of the experiment an independent valuer was called upon to value the two lots of cattle at the beginning and end of the experiment. The first valuation of the cattle was made on 15th December, 3 weeks after they had been placed on the experimental rations. The weights of the cattle were then almost identical and the valuer, probably deceived by the appearance of the coats, valued Lot I on silage at £13 per head and Lot II on hay at £11 15s. At the end of the experiment and after the rations had been changed over, the same valuer estimated the value of Lot I, now upon hay, at £18 and Lot II, now upon silage, and weighing only 14 lb. per head more than Lot I, at £19 2s. 6d. In other words on two occasions, at the beginning and end of the feeding period, when the two lots were almost identical in live weight, those fed on silage were

worth 25s. and 22s. 6d. per head more than those fed on hay. This case, though illustrative of the influence of silage upon the coats of stock fed upon it is extreme, and the writer does not wish to infer that silage had been responsible for such real differences in value as the figures express.

(4) Well-made silage is particularly good food for weaning calves, because being soft and succulent it is easily masticated and digested, and calves generally are less likely to become pot-bellied when this forms a considerable part of the ration.

(5) Silage is particularly valuable to the dairy farmer because of the reliability of the crop. The yield of mangolds both on very light and on very heavy land in the Eastern Counties is proverbially uncertain. Silage, though it will not produce the same quantity of food per acre as a good crop of roots, is much more reliable and therefore more satisfactory for the dairy farmer upon these soils.

(6) Cattle fed during winter upon silage are generally found to go ahead better when turned out to grass in spring than those fed largely upon roots.

(7) Silage is a good food for sheep. It may be fed in moderation, up to 14 lb. per day, to horses, but on account of its fibrous nature should not be fed in quantity to pigs.

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LAND DRAINAGE AND THE RIVER ROTHER: THE POSITION AT RYE HARBOUR.

IN this *Journal* for May, 1923, p. 113, there appeared an article headed "Land Reclamation: Some aspects of land reclamation with particular reference to the alleviation of unemployment." In that article certain examples were given to show how the cost of maintaining coast defences, especially in front of artificially reclaimed land, was crippling agricultural land in certain parts of the country; and among these examples was included the case of the river Rother (Sussex), the mouth of which for many years has been silting up owing to the littoral drift of shingle which has tended to block the mouth of the river. When the above article appeared the prospect was extremely gloomy, and it looked as if, in the absence of any remedial measures, the position would become increasingly difficult and that the mouth of the river would ultimately become so completely blocked that a vast fresh water lake would spread itself all over the marshlands drained by it.

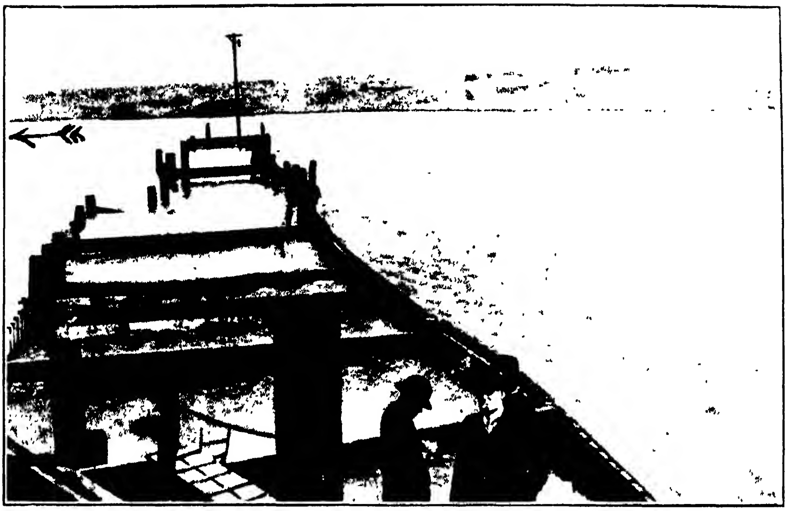

FIG. 1.—August 1924, showing obstructing Shingle Spit and End of Eastern Pier. Looking seawards.

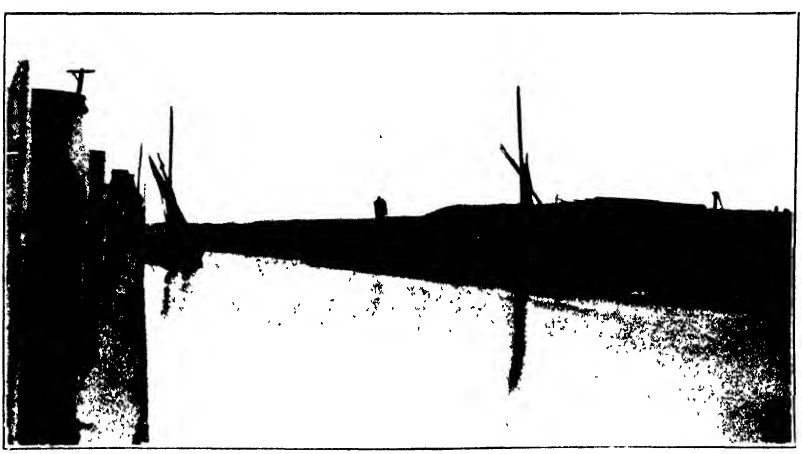

FIG. 2.—Rye Harbour 20th January 1925.

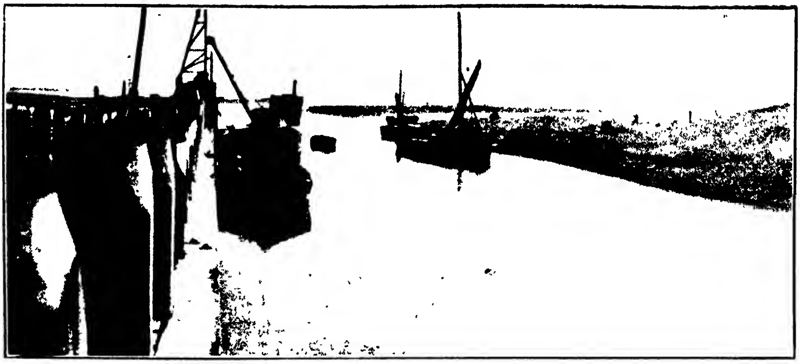

FIG. 3.—Rye Harbour, 19th March, 1925.

FIG. 4. 23rd August, 1924. The Shingle Spit. View from head of Western Training Groyne, looking East. The Eastern Pier extension would meet the spit where group is standing.

FIG. 5.—21st February, 1925. Showing break through Shingle Spit and extended Eastern Pier. Taken from new Western Groyne which contributed materially to the "Break through."

Those who are interested in the subject, and more especially those who are affected by the trend of events in this locality, will probably be glad to know that, by means of funds voted by Parliament for the relief of unemployment, the Ministry has been able to finance liberally certain works at the mouth of the river, which have been so far successful in achieving their object, namely, to create a straight run out for the river to the sea.

It is necessary to explain that the littoral drift of shingle in this locality is from west to east, consequently the river Rother was forced by a solid bank of shingle accumulating at its mouth to deflect its course at right angles from west to east for a certain distance and then to find its way out to sea as best it could round the edge of the accumulated shingle bank. The works that have been carried out by the Rother Levels Commissioners, with financial assistance from the State, include the construction of groynes on the right bank of the river mouth, which have had the effect of arresting the drift of further shingle. Simultaneously the eastern pier was extended with timber sheet piling so as to close the eastward run of the river and enable the ebbing waters to impinge upon and wear down the shingle spit on the river face.

The net result of both western and eastern works was to erode to a knife edge the shingle spit, through which the river was finally forced (in spite of a succession of gales which, by accumulating material, rendered the position at one time almost hopeless), by the closure of the eastward run, assisted in some measure by hand excavation of the shingle.

The position will be made clearer by the accompanying photographs. Figs. 1 and 4 show the state of the river mouth in August, 1924; Figs. 2, 3 and 5 show the development of the scheme, which has resulted in the river having a direct run to sea since 20th February, 1925.

It must not, however, be thought that these works are in any way final. In order to stabilise the position, it will be necessary to construct further western works in support of those already constructed, and all these works will have to be continued seawards as and when the shingle shows a tendency again to creep round the seaward end. Further, it will be necessary to deepen the river Rother throughout its tidal length where the accumulated matter has increased enormously in recent years and prevents the full benefit of the works at the river mouth accruing to the waterlogged lands of the valley.

These further works will, the Ministry hopes, be taken in hand and it is satisfactory now to record that what has been done has already acted as an incentive to the riparian owners to combine and take some action for securing the improvement and maintenance of this important drainage outfall.

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THE BEAN APHIS.

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THE Bean Aphis (*Aphis rumicis*, Linn.) which infests broad bean plants in early summer, is well known to the gardener and allotment holder, owing to the familiar black masses of these insects which are often found in dense colonies on the upper part of the stem and below the leaves. The insects are frequently referred to as "black fly," "black dolphin" or "blight." On the continent, this aphid is a serious pest of sugar beet, especially those varieties which are grown for seed. The insect has a wide distribution, and its occurrence in any particular season is largely affected by the prevailing weather, moderately high temperatures being especially favourable for its rapid increase in numbers. Although the broad bean is specially infested by this insect, it can live on a wide range of plants. Field beans frequently suffer heavy attacks and mangolds and red beet may also be attacked, but to a less extent. Certain common weeds such as docks (*Rumex*), poppies (*Papaver*), shepherd's purse (*Capsella bursa-pastoris*) and fat hen (*Chenopodium album*) are favoured summer food-plants, while the spindle tree (*Euonymus europæus*) is its known winter host, on which the fertilized eggs are laid in the autumn.

The following account of the life history and biology is based on a detailed study of this insect carried out at Rothamsted Experimental Station.

The Life History.—During its life cycle, the bean aphis appears under different forms which are represented in Fig. 1. Fertilized eggs (Fig. 1A) are laid on the branches of the spindle tree in October, near the base of the leaf buds or in crevices of the older branches, by the sexual females (Fig. 1F). The eggs hatch out in the following April, when the spindle tree is bursting into leaf. The young aphides feed on the buds and develop into the so-called "stem-mothers," or fundatrices (Fig. 1B). These wingless individuals became adult in about three weeks, depending on weather conditions, and then pro-

duce living young, which commence to feed on the buds almost immediately after they are born.* These young (first generation) generally develop into wingless females (Fig. 1C), but occasionally a few winged forms may be produced (Fig. 1D). After about a fortnight the first generation females become adult and produce living young of the second generation, the majority of which develop into winged forms (Fig. 1D). These are the spring migrants which migrate to the summer food plants. By early June, owing to the production of winged forms, most of the aphides have left the spindle tree, but small colonies may be found on cultivated *Euonymus* throughout the summer.

When the migrants alight on suitable food-plants, they produce living young which develop into wingless individuals, which in turn also produce living young. A large colony of aphides is therefore soon formed on an infected plant. Eventually winged forms (summer migrants) appear in these colonies and fly to other food plants, either of the same kind or of totally different species. Reproduction goes on in this way throughout the summer, resulting in several summer generations and a wide distribution of the insect. Temperature conditions considerably affect the rate of development and reproduction of the insects, but generally speaking in a favourable season, each aphid is capable of producing on an average about five young daily, with a total number of 40-50 young. The young may reach maturity after about 8 days, so that the numbers of aphides which may be produced in a season is enormous.

In September winged males (Fig. 1E) are produced in the colonies on the summer host-plants and the winged females which appear at the same time, although resembling the winged individuals of previous generations, are physiologically different, in that the young aphides they produce develop into true sexual, egg-laying females (Fig. 1F). These winged forms are the re-migrants. They fly back to the winter host (spindle tree) in late September and early October, and produce there the small, wingless sexual females (Fig. 1F). The males fly over to the winter host, pair with the sexual females, and fertilized eggs are eventually laid by the latter on the spindle tree.

* This phenomenon whereby the females of certain generations are able to reproduce without mating with a male, is the rule amongst aphides and is known as parthenogenesis. The production of living young, in contrast to the production of eggs, is also a common feature, the females being spoken of as viviparous females. It is a phenomenon which allows of the greatest number of aphides being produced, and is evidently an adaptation which ensures the widest distribution of these insects during the favourable seasons of the year.

Owing to the food plants dying down and bad weather conditions, the aphides remaining on the summer hosts die, but colonies may be frequently found until late in the autumn, and on suitable plants in sheltered situations, may carry on parthenogenetic reproduction throughout the winter. The writer has found colonies in December and January on the common shrub *Euonymus japonicus* in the south of England, and on small *Euonymus* bushes under frames near London throughout winter. Sexual forms may also be produced on plants other than the spindle tree, eggs having been found laid on docks and scarlet runner beans, but naturally a woody shrub like *Euonymus* is best suited as a winter host.

The Different Forms of the Bean Aphis.—During its life history the bean aphis assumes different forms, which are indicated in Fig. 1. These can be distinguished with the aid of a hand lens, but the reader is referred to the detailed description of the various forms given by the writer in Bulletin of Entomological Research, Vol. XII, pp. 81-89.

The general appearance of the insect is black, but the size and colour vary somewhat according to the food plant on which it is feeding. The various forms are as follows:—

(a) *The Stem Mothers*, Fig. 1B, which hatch from the fertilized eggs and are found at the end of April or in early May on the spindle tree, where they cause curling of the leaves of the young shoots. They produce living young, which form dense colonies on the plant.

(b) *Winged Females*, Fig. 1D, which are found on the spindle tree in May and later in the season on different food plants, to which they have migrated. They produce living young and further winged forms appear in the colonies from time to time during the summer, on various food plants.

(c) *Wingless Females*, Fig. 1C, which are found in May on the spindle tree and from May to October and often later in the season, on the summer food plants. They produce living young.

(d) *Winged Males*, Fig. 1E, which appear at the end of September and in early October on the summer food plants and fly to the winter host-plant (*Euonymus*).

(e) *Egg-laying Females*, Fig. 1F, which are found on the spindle tree in October, where they lay fertilized eggs which hatch out in spring.

(f) *Eggs*. Fig. 1A, which are laid on the spindle tree and hatch out in the following May; they are black.

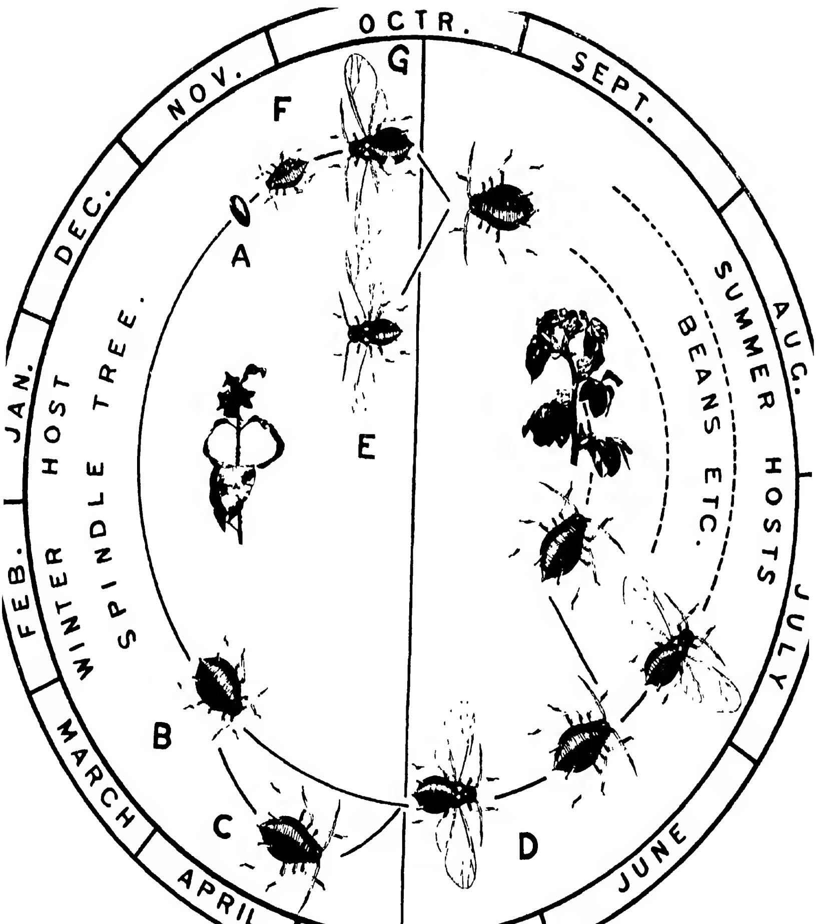

FIG. 1. Diagram illustrating the life-cycle of the bean aphis (*Aphis rumicis*) and showing the different forms the insect passes through. The period spent on the winter host is represented on the left half of the circle; that on the summer hosts on the right half. The sectors of the circle indicate the months and the concentric dotted lines a varying number of summer generations A. egg, B. fundatrix or stem mother, C. wingless viviparous female, D. winged viviparous female (migrant), E. male, F. sexual egg-laying female, G. autumn remigrants which produce the sexual females. The figures of the aphids are from original drawings.

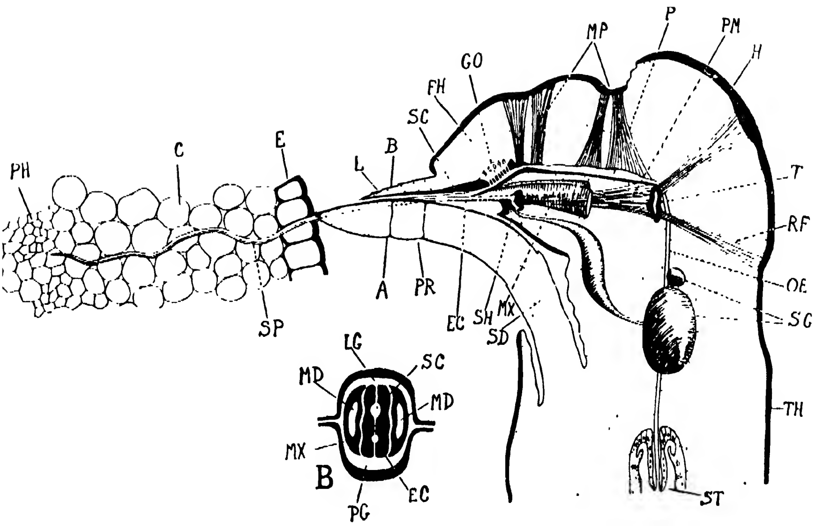

FIG. 2.—This is a drawing (much enlarged) showing the inside of the head and fore part of the body of the bean aphis, as seen in side view. The insect is in the act of sucking sap from a bean stem, the latter being cut across so as to show its cellular structure. The piercing mouth parts of the aphid *SP.* can be seen penetrating into the stem. Fig. B. shows the arrangement of the mouth parts in section when cut through at *AB.* The piercing organ *SP.* is seen lying supported in a groove *PG.* in the proboscis *PR.*

The relationship of the different parts will be understood by reference to the explanatory letters. *C.*, *E.* and *PH.*, cells of various parts of the bean stem. Saliva from the glands *SG.* passes along the tube *SD.* into the chamber *SH.*, and from thence is pumped down the piercing organ in the tube-like canal *EC.* into the plant tissues. *FH.* and *H.*, parts of the head of the aphis. The plant sap is sucked up the small channel *SC.* into the food chamber *P.*, and passed through the tube or œsophagus *OE.* into the stomach *ST.* The sap is tested by the taste organ *GO.*, before passing into the food chamber (*Pharynx*). *L.*, *LG.*, *MD.* and *MX.* are various structures composing the mouth parts of the insect. *MP.*, *PM.* and *RF.* are muscles which act on the different structures of the head and mouth parts during feeding. Strong supporting bars *T.* are present in the head, which support its various structures. *TH.* is the part of the body which joins on to the head.

Biology of the Bean Aphis.—It is seen from the remarks on the life history, that it is the rapid increase of the aphis in the parthenogenetic summer generations which results in the serious infestation of plants.

The insect feeds on the juices of the plant, the mouth parts being specially adapted for sucking out the sap from the plant tissues. The parts of the mouth which form the cutting mandibles and maxillæ in biting insects, are developed in aphides to form long, delicate, chitinous needles or stylets, which lie close together along a deep groove in the proboscis and form an efficient piercing organ, which is inserted into the plant tissues. The method of piercing the plant tissues is shown in Fig. 2. The two inner stylets lie closely apposed throughout their length and two canals are thus formed between them, as will be seen in the cross section (Fig. 2B). Along the upper or dorsal canal (S.C.) the food is drawn up into the pharynx (P) and from there passed backwards along the oesophagus (OE) into the stomach (ST). Along the lower or ventral canal (EC), secretion from the salivary glands (S.G.) is forced into the plant tissues while the insect is feeding. This salivary secretion is able to partially digest the sap, by changing starch into sugar. It also destroys parts of the walls of the cells thus facilitating the penetration of the piercing organ. The latter penetrates into the phloem region of the vascular bundles, which tissue affords the richest food (sap) for the insect.

The damage to the plant is caused by the tearing of the tissues by the piercing organ, by the destructive action of the saliva on the plant cells and by the weakening of the plant by the continual withdrawal of sap from its tissues.

At frequent intervals during feeding, the aphides excrete large drops of waste products. This substance is the so-called honey dew, which forms a sticky layer on the stem and leaves of the plants and the excretion from some species of aphides is particularly sought after by ants. It consists of the waste products of metabolism, and the undigested contents of the plant juices. In the case of some species of aphides, this excretion affords a suitable medium for the growth of moulds, which form a black deposit on parts of the plant, thereby affecting its powers of assimilation.

The degree to which plants are liable to infestation by *Aphis rumicis* may be affected by various factors, which are best discussed separately.

(a) *Influence of Climatic Factors on Infestation.*—The progress of infestation is considerably affected by temperature, owing to the fact that, in favourable warm weather conditions, the aphides reach maturity more quickly and produce more young daily, whereas in cold weather the reverse is the case. With a mean temperature of about 70° F., the aphides reach maturity in about 8 days, whereas with a mean temperature of about 55°F. the development may take as long as 18 days. Counts made of the number of aphides present on an unmanured bean plant, after 14 days' reproduction, commencing with one adult wingless female, showed that on an average (average of five plants) 1,340 aphides were produced when the mean temperature of the period was 71°F., whereas an average of only 460 was obtained for a reproduction period of 18 days, when the mean temperature of the period was 58°F. It is evident that the relation between the best temperature for the growth of the plant and that for the development of the aphid is an important consideration with reference to the infestation of cultivated plants by these insects. Aphides invariably attack young growing parts of the plant and, with slow progress of the infestation, the young growth would more readily overcome the effects of the attack. The climatic conditions during the 1924 season were not favourable for the rapid increase of aphides, and outbreaks of the bean aphis were small. Further, it was observed that young aphides which hatched from eggs during warm weather in April, were killed before they reached maturity by subsequent cold weather. This also reduced the chances of widespread infestation. Aphides are fragile insects and bad weather conditions generally, such as heavy rain and wind, result in many of them being destroyed.

(b) *Influence of Different Food-plants on Infestation.*—Although the bean aphis lives on a wide range of plants, it does not flourish equally well on all of them. Since its food is the plant sap, the suitability of the sap of different kinds of plants is a factor which affects the progress of the infestation. The following figures show the relative degree to which some of its food plants are liable to infestation. The figures represent the average number of aphides (average of five plants) produced on one plant during 14 days' reproduction, commencing with one adult wingless, viviparous female. The reproduction period for all the plants was taken during the same days, so that climatic factors were the same for all the plants. It will be seen that beans suffer the heaviest infestation :-

Plant.	*Longpod beans.*	*Sugar beet.*	*Red beet.*	*Mangolds.*	*Shirley poppies.*
Number of aphides produced.	896	123	115	114	164

(c) *Influence of Different Varieties of Beans.*—Different varieties of broad beans also vary in the degree to which they are liable to infestation, but the differences are small and unimportant, probably owing to the fact that the varieties are so closely related. The infestation figures obtained for a 14-day reproduction period, on four varieties, estimated as described in the preceding paragraph, are given below :—

Variety of bean.	*Longpod.*	*Windsor.*	*Mazagan.*	*Dwarf.*
Average number of aphides produced.	896	828	1,100	746

Several varieties of field beans were also tested and these showed rather greater variation in susceptibility to infestation. It was possible to group the varieties into classes, each class representing a different grade of susceptibility. Longpod broad beans were taken as the control, their susceptibility being taken as 100 per cent., and figures obtained for the other varieties were referred to this standard. Some of these varieties are given below, together with the degree of susceptibility of the groups to which they belong.

Class.	*Degree of susceptibility.*	*Varieties in the class.*
Control	taken as 100 per cent.	Longpod.
A	98	Bohus bean (Sweden). Mazagan.
B	55	Heligoland. Granton (Scotch var.)
C	39	Spring tick (Suffolk). Winter beans. Small tick. Carse. Kilbride.
D	3	*Vicia narbonensis.*

The high degree of resistance (97 per cent.) of *Vicia narbonensis* is interesting, as this is a wild type of bean, found in certain parts of the eastern Mediterranean area, and is considered by some authorities as the prototype of the cultivated bean (*Vicia faba*).

(d) *Influence of Age of Plant on Infestation.*—It is well known that aphides favour the young growing parts of plants and it was found by experiment that bean plants of one series, which were six weeks older than the plants in another series, when infected with the bean aphis in June, gave an intensity of infestation which was about 50 per cent. less than on the younger plants. This indicates the value of early sowing of beans where possible,

so that the plants may be well advanced before the winged aphides are about.

(e) *Influence of Soil Conditions and Manurial Treatment on Infestation.*—Soil condition is a factor affecting the growth of the plant, and the aim of manurial treatment of the soil is to improve the quantity and quality of the crop. In this way changes produced in the juices of the plant influence the development and reproduction of the aphides feeding on them. Field observations indicate that the condition of the soil has an influence on infestation, but conclusive experimental evidence on this question is not yet available. It is interesting to note, however, that the intensity of infestation on beans grown in sand watered with normal food solution, was found to be greater than on beans grown in unmanured soil watered with the same solution.

The progress of infestation on beans grown in unmanured soil was found to be slower than on bean plants which received complete artificial manures. The relative intensity of infestation on bean plants grown under different treatment, estimated as explained above, is shown below.

Treatment of Plants. (*Longpod broad beans.*)	*Intensity of Infestation.* per cent.
Grown in sand, unmanured, watered with tap water only.	Control taken as 100.
Grown in sand, watered with complete food solution.	225
Grown in soil, unmanured.	140
Grown in soil, manured with complete artificial manures.	200

Further experiments with beans grown in sand showed that absence of potash in the culture solution with which the plants were watered resulted in a decreased infestation, whereas with increased potash and phosphates a heavier infestation was obtained. These preliminary results afford sufficient evidence that the relation between soil conditions and the manurial treatment of plants and aphis infestation, is worthy of further investigation.

Control Measures.—We have seen that weather conditions play an important part in favouring or restricting the progress of aphis infestation. In addition, the bean aphis is to some extent controlled by Ichneumon parasites and their allies, which lay their eggs inside the bodies of the aphides. The grubs, which hatch out from these eggs, feed within the aphides, thereby killing them.

(a) *The Farm.*—Owing to the rapid progress of aphis infestation during favourable weather it is difficult satisfactorily to deal

with an infestation on a field scale once it has become well established. Good cultivation and manuring which produce strong, healthy plants, will enable the plants to recover more readily from a temporary outbreak. Certain types of field beans, referred to in a previous paragraph, which are less susceptible to infestation, might be grown where suitable.

Early sowing is desirable, as in this way the plants are well advanced before the winged aphids are about and the chances of heavy infestation are less.

In the early stages of an attack (May), a few heavily infested bean plants may be noticed in the crop, and if these are cut down it will obviously reduce the chances of a wider infestation.

Since *Aphis rumicis* has many food plants amongst so-called weeds, such as shepherd's purse, fat hen, docks and poppies, their presence assists the spread of an infestation. Beans are frequently heavily attacked, and it is inadvisable to grow other susceptible crops such as sugar beet and mangolds near to a crop of beans, owing to the possibility of migration from the beans to the other crop.

It may be thought that by the eradication of the spindle tree the pest could be controlled. In fact destruction of *Euonymus* has been advocated in certain parts of France, as a method of control of this aphis on sugar beet. This, however, would not, I believe, have the desired result in England. The wild spindle tree is locally distributed and not very common, and although it has been proved to be a winter host of *Aphis rumicis*, the insect can winter in other ways. Colonies have been found on mangolds growing in a rubbish heap and eggs have been found laid on the leaves of sugar beet in France in October. Under experimental conditions the writer has found eggs laid on beans in October. A very important consideration, however, is the fact that the aphis can carry on parthenogenetic reproduction throughout the winter in warm sheltered situations. The writer has carried on continuous parthenogenetic generations of this species for four years on beans. Living colonies have been found in winter on the common evergreen shrub *Euonymus japonicus* in the South of England, which increased enormously in numbers in the warm days of early spring. With warm conditions a rapid increase of the winter colonies and the production of winged forms would soon result in a wide district being infected.

(b) *The Garden and Allotment.*—The gardener has an easier task in controlling the infestation on broad beans than is the case with the field bean crop, but the remarks in the previous

paragraph also apply to the garden crop. Rhubarb which is running to seed and asparagus should be watched for colonies of the bean aphis in early summer. *Euonymus japonicus* is a common garden evergreen shrub on which the aphid feeds, and in sheltered situations, especially where pot plants of this shrub are kept under frames in the winter, colonies of the insect may be found throughout the winter, thus affording a source of infection the following spring. Plants which are kept under frames or in greenhouses during winter should be watched for any signs of the bean aphis. Another species of aphid, *Myzus persicæ*, is frequently found on greenhouse plants in winter.

In the early stages of attack the young growing tips of the bean plants should be removed, as the aphid colonies invariably start at the growing apex of the plant, and this procedure reduces the progress of the infestation.

Where necessary the plants should be sprayed with a contact insecticide, the best type being one containing nicotine. Formulæ of suitable insecticides, together with instructions for spraying, will be found in the Ministry's leaflet No. 37.

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APPLE PACKING.*

J. STODDART, J. TURNBULL and A. WHITING,
Ministry of Agriculture and Fisheries.

FROM the correspondence which has recently appeared in the technical press it would seem that the principles of fruit packing, particularly in regard to the boxing of apples, are not so clearly understood as they might be. The methods employed in box packing were dealt with in a previous article,† and we shall now explain some of the principles underlying those methods. In the disposal of apples there are many factors which are interdependent, and because of this the subject is treated more widely than may appear necessary.

Grading.—In general, grading means the removing from a bulk of fruit of all specimens which are below normal size, blemished, damaged, malformed or not typical of the variety. In the case of apples further separation is made in regard to size and colour, and attempts are being made to fix a standard of grades for apples.

That the grading of fruit is profitable to the producer is accepted by all who practice it, and such acceptance must be taken as proof by those who do not grade their fruit. In

* This article should be read in conjunction with the Ministry's Leaflet No. 98.

† This *Journal*, Sept., 1921, page 531.

attempting to prove the value of grading, isolated consignments are misleading. Even the results of a number of trials of equal lots of graded and ungraded fruit do not indicate the position accurately, because the grower who changes over has to live down his reputation for marketing ungraded fruit, and at the same time build up a reputation for honest grading before he can expect to reap the benefit.

Marketing.—The grower who markets ungraded fruit must not think that the prospective buyer is to be misled into paying the same price for "culls" as for graded fruit. The buyer who purchases large quantities of fruit has no time to spare for detailed examination and will only look at consignments which are well known to be honestly graded and packed. Some other buyers will buy ungraded packs, *but only after careful examination*, and the price offered is generally based on the estimated amount of good fruit present. In these cases the estimated value is rarely very profitable to the grower, and the general result is that the "culls" realise nothing, although the grower has paid freight, package, tolls and other charges on them. In times of glut ungraded packs are slaughtered.

The sizing of fruit varies in importance according to the kind, but with apples sizing is of the greatest importance. The separation of graded apples into uniform sizes invariably results in an improvement in the price realised for the bulk, no matter what type of package is used.

Packages.—There are two classes of packages for apples, viz., returnable and non-returnable. These are further divided in accordance with the purpose for which they are used: (1) for distant markets, and (2) for local markets where no second transit is incurred.

Returnable—Distant market.—The main considerations for packages for this purpose are durability, protection of contents, weight, cost and their utility as containers for various fruits and vegetables. In the past, many types of containers have been used, but those found to be uneconomic have been almost eliminated, while the round wicker bushel, half-bushel and strike have become almost standard packages. For cooking-apples, the half-barrel (or grape barrel) is largely used, particularly in the Midlands and the North, and is a satisfactory package. The "Pot," although generally condemned for fruit, is still used on a small scale in the Midlands.

Returnable—Local Market.—Where produce is sold locally various kinds of established types of packages are used, including

once-used non-returnables, which are purchased from retailers at a reduced price. In some districts special types of strong bushel and half-bushel boxes are used, but these have no definite standard; they are used for all kinds of market garden produce, and their uniformity and rigidity allows the safe stacking of high loads. These boxes are quite satisfactory for the local disposal of apples by weight.

Non-returnable—Distant Market.—For distant markets the non-returnable package is essential. Besides clearing away the worries and cost of returning, it increases the speed of distribution, extends the area of disposal, and finds universal favour with the retailer.

The requirements of a package for dessert apples does not always coincide with those required for cooking apples, but experience proves that the Standard Box (described in detail later) is the most suitable package for the *best grades* of dessert varieties, and quite satisfactory for some cooking varieties. It ensures the safety of the contents during long transit and much handling. Various types of chip packages are in use but, as yet, these have not fully established themselves as apple packages.

It is by no means certain that finality in design in the standard box has been reached, and it is possible that a different and better type of package may be produced. For the present, however, its supremacy for high-class, graded dessert apples is unquestionable.

The following points must be considered when evolving new types of packages for apples:—

Cost.—This is of the greatest importance when all other points are equal.

Shape.—Rectangular packages require to be approximately square on the transverse section in order that the diagonal pack may be used.

Durability.—This must be sufficient to give adequate protection to the contents in normal conditions of transit and handling.

Weight.—Transport charges make the weight of packages a matter of considerable importance.

Stacking.—A successful package must bear stacking to a considerable height without damage to contents.

Although the standard bushel box is suitable for bulk disposal of dessert apples, there is undoubtedly also a need for a smaller package which can be sold intact to the consumer, and some development in this direction is desirable. As regards packages

for cooking apples, a few growers have used the standard box for some years with satisfactory results, but experience is limited, and it is not yet possible to gauge the extent of the demand for this package. Search for a more suitable package is being made.

To a small extent, half-barrels are used as non-returnables, but they are usually too costly for the purpose.

Non-Returnable—Local Market.—For produce sold locally new non-returnables are being increasingly used for soft fruits, because such packages can be sold to the consumer intact. The sale of intact packages of apples has not yet developed to any extent, but considerable scope is offered if a suitable package can be produced. For local trade it is possible that a comparatively frail package would serve the purpose.

Standard Apple Box.—The internal dimensions of the rectangular bushel box adopted in Great Britain as standard are 18 in. long, $11\frac{1}{2}$ in. wide, and $10\frac{1}{2}$ in. deep. The ends and sides are rigid, but the top and bottom boards bend under pressure.

This box appears to have originated in Oregon and has replaced the American and Canadian standard package of 20 in. by 11 in. by 10 in. It is probable that the development of the "Diagonal" pack (described later) was the cause of the change-over, but the main reason is that the standard 18 in. box will take a longer range of 3—2 packs than the older 20 in. box.

The previous statement that a box to take the diagonal pack should be square in transverse section appears to be contradictory in view of the dimensions given above. This is explained by the fact that when the standard box is filled, the depth at the centre is 12 in. to $12\frac{1}{2}$ in. and at the ends $10\frac{3}{4}$ in., the average depth being approximately $11\frac{1}{2}$ in., so that the filled box is nearly square in transverse section. If no "bulge" were used the box would need to be $11\frac{1}{2}$ in. by $11\frac{1}{2}$ in. by 18 in.

The sizes and thicknesses of the wood for the standard box for use in Great Britain are as follows :—

Ends	2 pieces	$11\frac{1}{2}$ in. long	$10\frac{1}{2}$ in. wide	$\frac{3}{4}$ in thick.
Sides	4 ,,	$19\frac{1}{2}$,, ,,	5 ,, ,,	$\frac{5}{16}$,, ,,
Top and bottom	4 ,,	$19\frac{1}{2}$,, ,,	5 ,, ,,	$\frac{3}{16}$,, ,,
Cleats	4 ,,	11 ,, ,,	$\frac{3}{4}$,, ,,	$\frac{1}{4}$,, ,,

All boards must be sound and free from knotholes and cracks.

The end pieces may be made of battens and a thin board instead of one piece, provided the dimensions are the same. For export it is advisable to make the sides $\frac{3}{8}$ in. thick and the top and bottom boards $\frac{1}{4}$ in. thick.

The object of making the top and the bottom boards thin is to enable them to bend when the box is being nailed down. The

bending of these boards produces a bulge which tightens the pack; this is essential for safe transit and handling.

The "Bulge."—The curved top and bottom on a box of press-packed apples are known as the "bulge." The object of this bulge is to keep the pack tight and firm, without bruising the fruit. Apples will support considerable pressure, if evenly applied, without bruising. Pressure from a sharp edge, however, will cause bruises, but bruising is more frequently caused by the jolting of apples which have been too loosely packed in the box.

When the top boards are nailed, the apples are pressed down and the bottom boards bend equally with the top. These boards act as a spring and provide the pressure to keep the apples from jolting. This pressure is necessary because apples cannot be packed tightly enough by hand, and it also compensates for shrinkage in transit and storage. The "Diagonal" pack, (explained later) causes the pressure to be distributed evenly throughout the box. In a well packed box with 1½ in. bulge there is no risk of damage to the contents. Although continued pressure may produce slight flats on some apples when imperfectly packed, it does not set up the rot which follows a sharp blow.

With the most efficient sizing apparatus there still remains a variation in size, and advantage is taken of this by selecting the apples as they are placed in the box, to produce the required bulge. The slightly smaller apples are placed at the ends and graduated in size towards the middle of each layer in the box (see Fig. 4). By this means the apples in a filled box project from ¼ in. at the ends to 1—1½ in. in the middle.

As the variation in transverse diameter between apple and apple may not exceed $\frac{1}{16}$ in., it would appear that selecting for packing would be a tedious and lengthy process, but a few hours' practice enables the average packer to select, wrap and place apples with speed and accuracy. A packer of moderate experience can select, wrap and pack 200 apples in 10 minutes. As the necessity for the bulge in the standard box has been a matter for discussion, it was decided to send a consignment of boxes (approximately the same size as the standard box) without a bulge, together with some standard boxes with the bulge, from various parts of the country to London. On arrival the contents of the boxes were examined and the better condition of the fruit in the standard boxes proved conclusively that the bulge is necessary.

The bulge has the additional advantage that, when the box is opened, the spring of the bottom raises the apples slightly, and gives the box a full appearance, while the box without a bulge appears to be insufficiently filled.

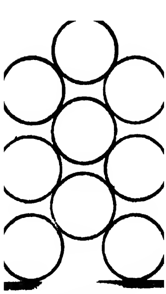
Diagonal Pack.—When the 20 in. box was first used, the first layer only was "faced" and the remainder of the apples "filled in," just as headed barrels are filled to-day. Then packing in straight rows began, but difficulty arose in getting the apples to the right height. To rectify this some apples were turned one way and some another, and there was a different method for every size of every variety. The present 18 in. box was eventually introduced, and for a time both boxes were used. Later it was found that any size or shape of apple could be packed to the correct height in the 18 in. box by placing the apples on the side in diagonal instead of straight rows. This system so simplified box packing that unskilled workers could obtain good packs, and its introduction has undoubtedly accelerated the use of boxes for apples. The main advantages of the diagonal pack are :—

(1) All sizes of apples can be packed on the cheek in the standard box, so that they fill the box to the required height.

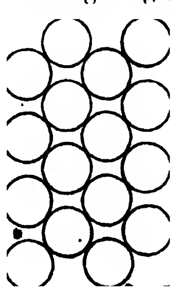
(2) The pressure of the top and bottom boards is evenly distributed over the greatest possible area of fruit surface.

(3) An orderly pack is a visible guarantee of uniformity in size.

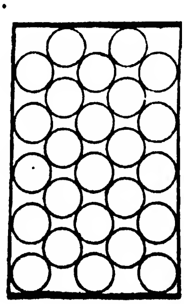
The diagonal pack automatically provides for a primary division of sizes into groups, which are indicated by the number of apples in each of the first two rows across the box; thus, 2—1, 2—2, 3—2 and 3—3, the first figure indicating the number of apples in the first transverse row against the end, and the second figure the number in the next transverse row as shown in the following diagrams.



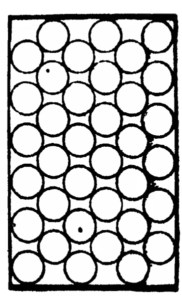
1st layer (2—1 × 3—3)



1st layer (2—2 × 4—4)



1st layer (3—2 × 5—5)



1st layer (3—3 × 6—6)

The limiting factor in each group is the number of apples of equal diameter which will lie touching along the diagonal of the box end and project ½ in. above the top. Thus the largest size for 2—2 pack gives 4 apples diagonally across the end, 3—2 gives 5 and 3—3 gives 6. This can be seen so far as the 3—2 group is concerned in Figs. 5 and 6. There is, however, a certain amount of overlap between groups as the smaller sizes of the larger group will pack the same packs as the larger apples of the next smaller group. The average diameter and average length of the various sizes within the groups control the number of apples in the longitudinal rows.

To demonstrate the diagonal pack clearly, the illustrations show a box with one side and one end which have been made of glass, the bottom being bent to the normal curve of the "bulge."

It will be seen that all lines of *apples which are in contact* are disposed diagonally in relation to any rectangle formed by the edges of the box. It is from this characteristic that the pack derives its name.

To indicate clearly the reason for the constant height, no matter what size of apples is packed, it is advisable to consider that the box has been filled with transverse vertical layers (*i.e.*, layers parallel with the ends) instead of horizontal layers. In Figs. 5 and 6. which show extremes of the 3—2 group, the first layer against the end contains 13 apples symmetrically placed. The large apples in Fig. 5 are almost in contact, leaving very small pockets into which the second vertical layer fits. The small apples shown in Fig. 6 are placed in exactly the same positions as those in Fig. 5, but they provide larger pockets into which the second vertical layer fits. The number of apples in the second layer is equal to the number of pockets in the first layer, viz., 12.

It is obvious that with decreasing sizes of apples, and the resulting enlargement of pockets, the proportion of the length of the box occupied by each layer decreases, while the height and breadth of the layer remain the same. This is clearly shown in Fig. 3, which contains 9, and Fig. 4, 16 vertical layers. In all counts of the 3—2 pack the number of lengthwise (or horizontal) layers is 5.

The largest size of round apple for the 3—2 pack is that which gives 8 transverse vertical layers with 100 apples to the box. Successively smaller sizes add to the number of such

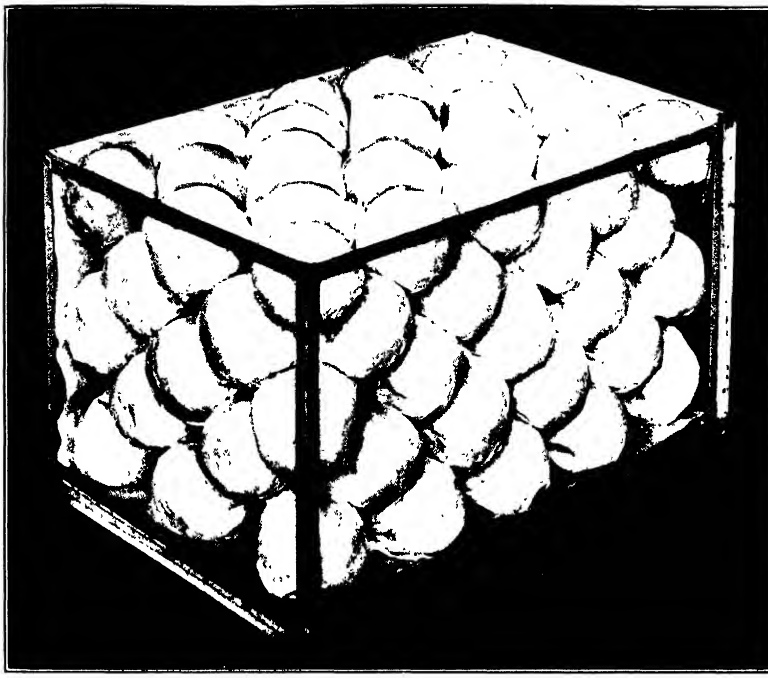


FIG. 1.—Corner view of 3—2 pack, 113 apples.

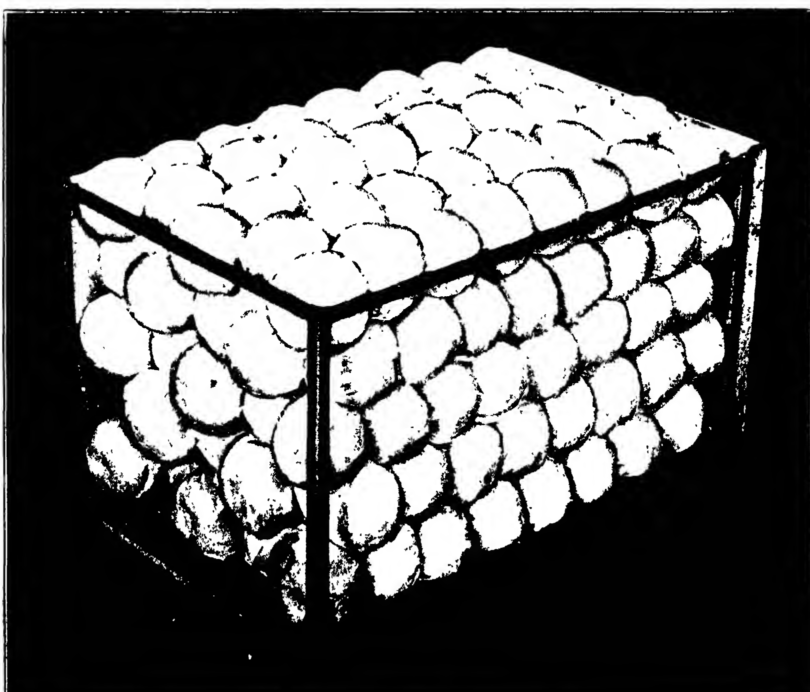


FIG. 2.—Corner view of 3—2 pack, 200 apples.

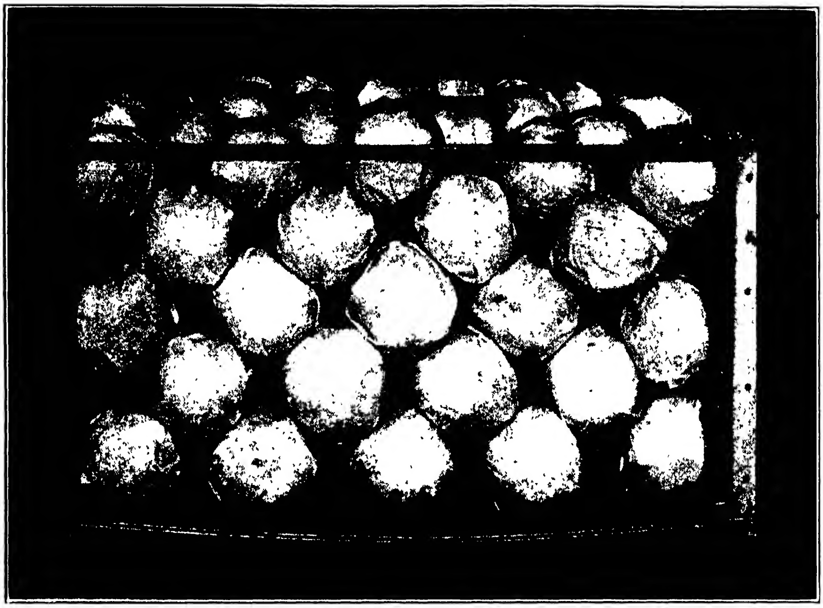


Fig. 3.—Side view of 3—2 pack, 113 apple

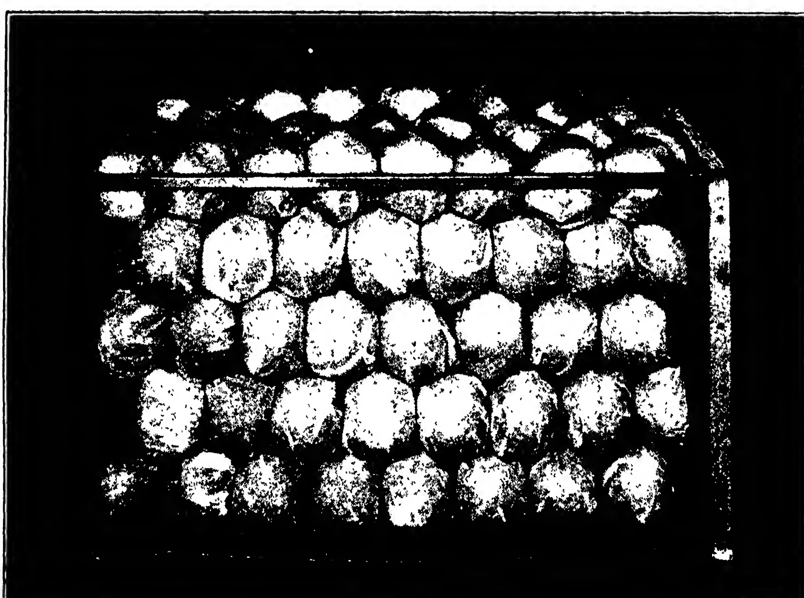


Fig. 4.—Side view of 3—2 pack, 200 apples.

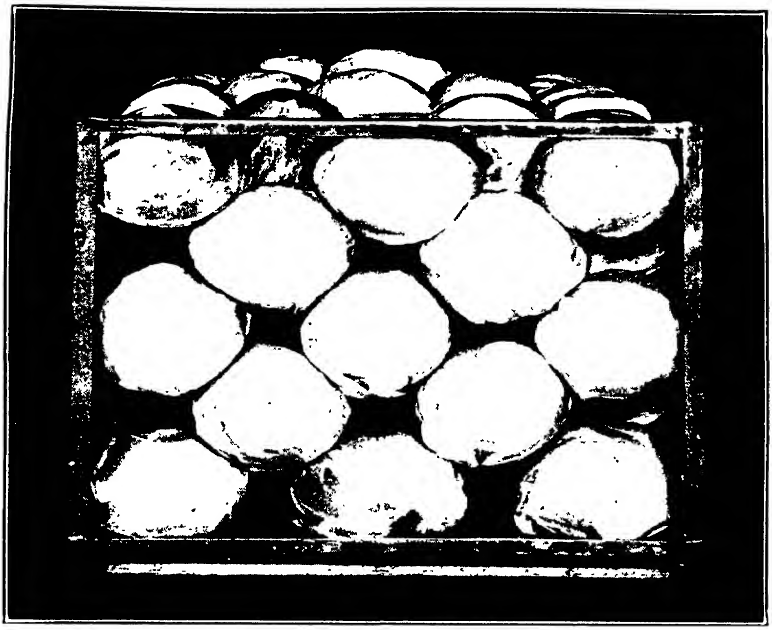


FIG. 5.—End view of 3—2 pack, 113 apple[s]

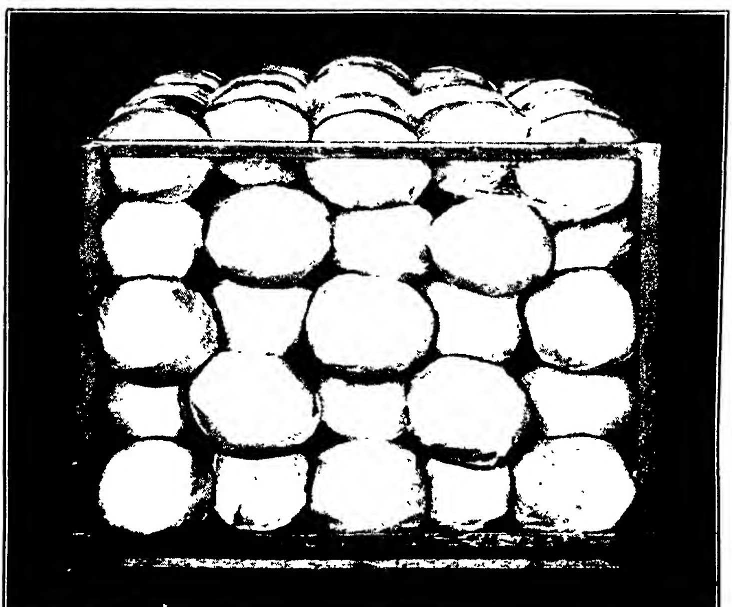


FIG. 6.—End view of 3—2 pack, 250 apples.

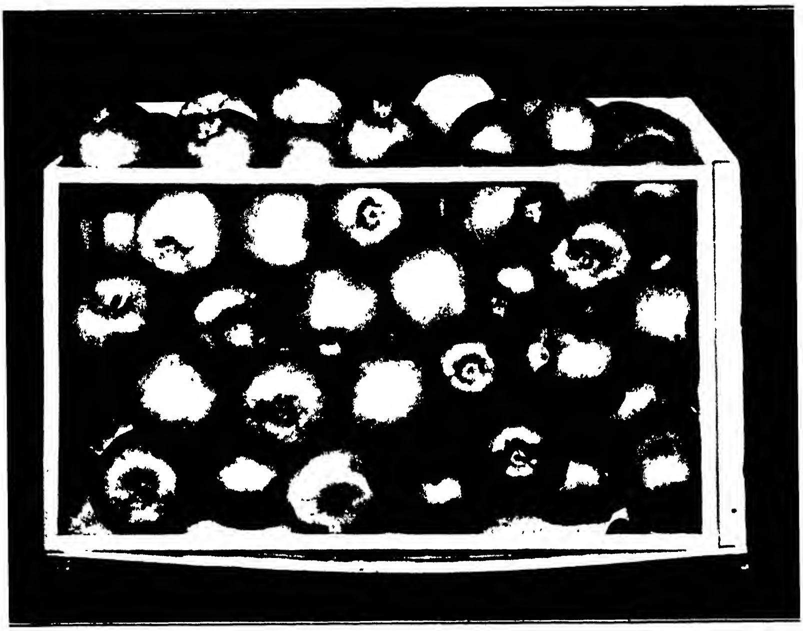


FIG. 7.—The same apples as shown in Fig. 1, unwrapped and not regularly packed.

layers, each additional layer adding 12 or 13 to the previous total. This progression is clearly indicated in the following table, which refers to the 3—2 pack only:—

Fig. 1 Fig. 3

Numerical order of Transverse Vertical Layers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Number of Apples in Layer	13	12	13	12	13	12	13	12	13	12	13	12	13	12	13	12	13
Total Apples in box	—	—	—	—	—	—	—	100	113	125	138	150	163	175	188	200	213
Number of Apples in Longitudinal Rows	—	—	—	—	—	—	—	4-4	4-5	5-5	5-6	6-6	6-7	7-7	7-8	8-8	8-9

The same principles apply to the other groups. In the 2—1 there are 5 and 4 apples alternately in the transverse vertical layers. In the 2—2 there are 8, and in the 3—3 18 apples to each such layer. A full list of packs is given in the Ministry's Leaflet No. 98.

The use of the diagonal pack is of the greatest importance in the distribution of pressure. Each outside apple has 6 or 7 points of contact according to its position, and each interior apple is in contact with other apples at 8 points. When pressure is brought to bear on an outside apple it is transmitted, in part, to each of the apples with which the first is in contact, but the direction of the pressure is at an angle to that of the original movement. The second apples each again transmit the pressure received at their points of contact and so on until the pressure at each contact is equal. The movement can be observed when the top boards are pressed on a full box. This automatic distribution of pressure permits of a slight variation in the size of the apples, and adjusts inaccuracies in packing.

The diagonal pack not only gives a visible guarantee of uniformity, but it enables apples to be packed in the smallest possible space. The apples shown in Fig. 1 have been unwrapped and placed without order in the same box, Fig. 7, and in order to secure a level surface it was necessary to remove 12 per cent. of the contents.

The wrapping of the apples in paper has many advantages. It has the effect of putting a thick skin on the apple, which protects it from bruises. It also tends to prevent the spread of rot, and adds to the appearance of cleanliness. Further,

it actually takes less time to wrap and pack a box of apples than it does to pack them unwrapped. Although it is thought by some growers that box packing is difficult and costly, experience has shown that unskilled workers may be trained to pack "sized" apples correctly in two or three days, and that the wages of this work at the present time amounts to 1½d. per bushel. There are few places where extra labour cannot be obtained in the packing season, and if the grower is already going to the expense of grading and using non-returnables, it would seem a pity to grudge the very small extra cost of packing on the diagonal system.

We are convinced that, if growers are to retain a reasonable share of the home market, no other course is possible for them but to adopt box-packing for those apples which are suitable for boxing for disposal in those markets which can handle boxed apples to advantage.

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POTATO TUBERS AND SPROUTS: THEIR VALUE IN IDENTIFYING VARIETIES.

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THE identification of a potato variety is often a matter of extreme difficulty. During the growing season the various types are generally recognised by differences manifested in the foliage and inflorescences. Nevertheless, there are times when accurate determinations can be made only by reference to the underground parts. It has thus become necessary to consider the plant as a whole, and any aid afforded by the tuber and sprout must not be neglected. Moreover, it is desirable that all concerned should be able to place the various varieties in their tuber groups during the winter and spring months. It is proposed in the following notes, therefore, to emphasise all points which are useful in diagnosis.

Tuber.—Shortly after the potato haulm appears above ground, stolons develop in the axils of the scale leaves on the underground portion of the stem. These stolons lengthen for several internodes and ultimately swell at their tips to form tubers. The change from stolon to tuber is quite abrupt. Extensive cell division takes place in the pith, and much less in the outer cortical regions, hence the vascular tissue in passing from stolon to tuber bulges outward and is to be found not far

from the skin. Later, growth in size results from active division of cells lying between the cortex and the pith, divided into two unequal parts by the narrow vascular ring. These become the chief starch-containing cells. On cutting a mature tuber it is easy to recognise the vascular cylinder which lies, roughly, about $\frac{1}{8}$ of an inch below the skin. This cylinder encloses a large amount of storage tissue and the pith, while externally there are more storage cells as well as the cortex proper, although popularly both the latter are referred to as the cortex. In the young stolon the cortex occupies a large area compared with the organ as a whole, but in the later development of the tuber the cortex adds little new tissue and hardly more than doubles the number of rows of cells in the radial extent.* While the tuber is expanding, fine strands of the vascular bundle are formed amongst the pith and storage cells. The bundle can be clearly traced entering the heel-end of the tuber from the stolon and sending branches into each eye or bud produced by the tuber. As the vascular cylinder is the part mainly concerned in distributing the sap which afterwards gives rise to starch, its amount is about the same in a stolon and in a tuber, but in the latter it forms an open meshwork rather than a closed cylinder. The pith forms the central part of the tuber and it is broadest near the middle. It gives off lateral branches, which communicate with the eyes, and it terminates at the apex of the tuber. The entire tuber is covered with a corky skin or periderm about 6 layers of cells deep in thin-skinned varieties, increasing up to about 10 cells in rough-skinned varieties. The skin is pitted with lenticels which have developed underneath the stomata of the young stolon tip. Under favourable conditions these become quite visible as white dots owing to a proliferation of their tissue. The lenticel performs the function of aeration.

The tuber is morphologically a shortened, thickened stem with scale leaves. In the axils of these leaves lie the eyes. Each eye is a collection of buds lying more or less in a depression. The number of buds in each eye may be great, but three is the usual figure. Actually, the eye is a lateral branch with undeveloped internodes. Thus it will be seen that the tuber is a branched shoot system and not a simple shoot. The spiral of the eyes is towards the left, but occasionally right-hand spirals are found. At the rose end or the apex of the tuber the eyes are more crowded than at the heel or stolon end.

* Antschwager, E. Studies of the Potato Tuber. *Jour. Agric. Research*, Vol. XXVII, No. 4.

A study of the characters of the tuber useful in diagnosis will be facilitated by first discussing differentiating points which are apparent during the growing season only and which disappear at maturity.

Potato breeders in appraising the value of their seedlings have always taken into consideration the proximity of the tubers to the mother plant. Hence it is that in very few varieties are tubers formed at a distance from the stems. Nevertheless, there exist amongst varieties differences in the plan of the tuber positions. Generally, early varieties form tubers near the surface. Some earlies, however, *e.g.*, Di Vernon, have this peculiarity developed to a very considerable extent, while others, *e.g.*, Eclipse, Witchhill and America tend to form tubers in tiers and they are thus not so readily exposed. Late varieties differ in their settings, few having tubers very close to the parent. Golden Wonder and Langworthy are types, however, which show a distinct disposition to deep tuber formation, while Templar, Dominion and Irish Chieftain having comparatively long runners, set tubers at some distance from the mother plant. The development of aerial tubers is characteristic of certain varieties. This phenomenon, known as supertuberation, is frequently due to accident, hence its occurrence may be associated with weakness of some kind in the haulm. It occurs frequently in Edzell Blue.

It has already been mentioned that the eyes of the potato tuber lie in the axils of scale leaves. These scale leaves are coloured in certain white-skinned varieties, the colour corresponding with that of the sprout and forming an extraordinarily useful feature in identification work. The scale leaves of May Queen, Conquest, Wilson's Seedling (338/2), Irish Chieftain, the Grey-leaved Rogue* and many other varieties are generally blue, while those of Fiftyfold are pink. It frequently happens in white varieties that the heel end of the tuber develops colour during the growing season as also does sometimes the rose end. The heel ends of Arran Chief and Abundance are blue, while those of Lymm Gray, Epicure and occasionally King George are pink. Immature tubers with pink rose ends are frequently found in Rhoderick Dhu and King George. The classification of tuber shapes shown on pp. 260-1 has been compiled from a study of matured, well-grown tubers. During the growing season, especially in July and early August, it is not always possible to form an accurate idea of the type, if small immature

* See *Miscellaneous Publications, No.* 3, Board of Agriculture for Scotland.

tubers only are available for examination. This difficulty is most pronounced in varieties with oval tubers.

The characters of the tuber which persist after maturity and which are useful in diagnosis are :—(1) Shape, (2) Colour and condition of skin, (3) Position and depth of eyes, (4) Colour and consistency of the flesh, (5) Type of second growth, and (6) Microscopic characters.

Shape.—Each variety has its typical tuber shape. Soil conditions, however, may greatly impair the development of this shape, the potato being apt to follow the line of least resistance. There is in consequence no rigidity of shape in any variety, and even on one plant several tuber forms may be found. Nevertheless, despite variations, a precise conception of the varietal type can be obtained usually by the study of a number of tubers, when the inconstant features are apparent. Except in spherical varieties each tuber has normally an upper and a lower surface. The upper surface practically always possesses more eyes than the lower and in most cases it is rounder than the latter. The true shape is visible when the tuber lies on its lower surface. When thus viewed, the tuber outline may appear round or to have a long axis. In the former case, the tuber may be spherical or pebble-shaped; in the latter it may be pear-shaped, oval or conical according as the largest diameter occurs towards the rose-end, about the middle or towards the heel end respectively. Tubers may be thin, thick or of medium depth according to the thickness of the cross section. Very frequently it is found that the stolon joins the tuber in a depression. When such is the case, the tuber is spoken of as having a recessed heel end, a condition prevailing in the following varieties :—America, Champion, Rocks, Early Pink Champion, Fortyfold, Buchan Beauty, Gregor Cups and Epicure. The depth of the recess is correlated with the depth of the eyes. Varieties with pear-shaped tubers seldom show the recess: indeed, these often exhibit the reverse character, namely, pointed heel ends, such as are common in King Edward. The classification on pp. 260-1 gives in tabular form the tuber shape of most common varieties. It must be kept in view that the finer the distinctions the more difficult it is to place the various types, especially if few tubers are available for examination. Generally, however, it is quite easy to relegate a variety to its position in the larger groups, viz., round, oval, conical or pear-shaped. Some long-oval and pear-shaped tubers show slight curving of the main axis, so that the tuber resembles a banana—a form frequently found in May Queen

Colour and Condition of the Skin.—Potato tubers may be coloured, parti-coloured, white or russet.

Coloured Tubers.—The colour of the skin is only fully developed when the plant reaches maturity. The intensity of the colour, however, depends largely on soil conditions—in sandy and peaty soils, the colour is usually highly developed, whereas in clay there is marked diminution of the intensity. The colour is at its highest in autumn and with age it fades slightly. The red and blue colouring is due to a pigment—anthocyan—dissolved in the cell sap of the periderm and the peripheral cortex. Distinctions may be drawn within each of the two groups. Thus Eightyfold is not so densely coloured as Edzell Blue, nor Arran Rose and Early Pink Champion so deeply as Flourball. The different tones and shades of colour cannot be described in words without reference to a chart, but with practice, the reader can readily familiarise himself with the various types and the modifications of these consequent on variations in soil. In some varieties, *e.g.*, Rector, the eye tissue is much more highly col-

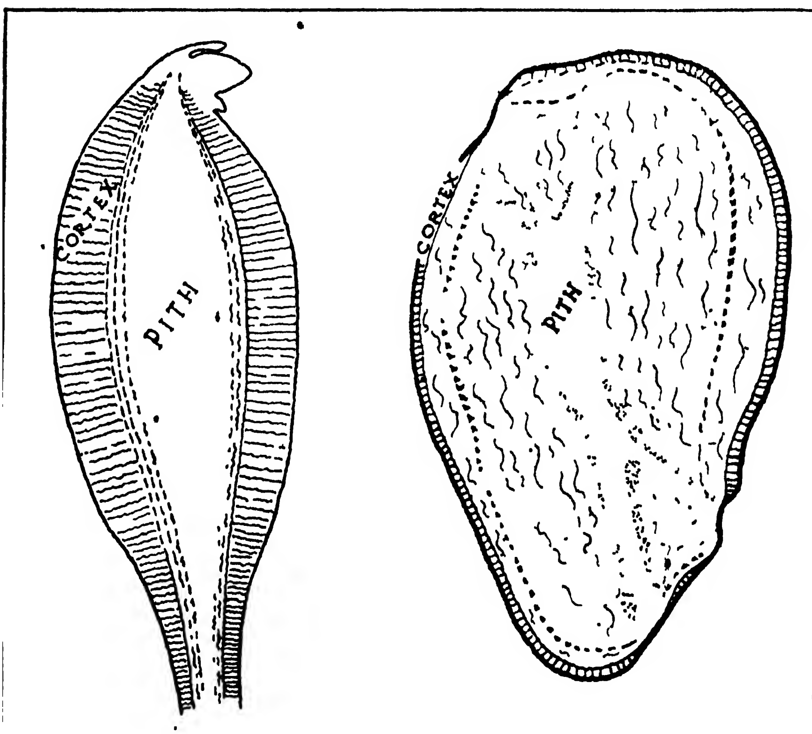

FIG. 1.—*Left*, Radial Section of Stolon Tip (x 9), and *Right*, Native Tuber (nat. size), showing homology of tissues (after Antschwager).

oured than the remainder, a characteristic quite useful for identification.

Parti-coloured Tubers.—In parti-coloured tubers the pigment is the same as described above; its distribution, however, is not uniform but localised, some of the skin being white. In most parti-coloured tubers the colour is situated mainly in the region of the eye, *e.g.*, Di Vernon, King Edward, K. of K., Katie Glover, Northern Star, Lochar, Catriona, and Beauty of Bute. In other varieties, *e.g.*, the Apple, this condition is reversed, the tissue about the eyes being white and the remainder coloured. Finer distinctions can be made in this group than in the previous one, and the basis of these distinctions is the relative amount of colour present. In some types, *e.g.*, Northern Star, Lochar and Marquis of Bute, the pigment develops in the region of the eyes and lenticels, but only faintly, if at all, elsewhere; others, such as Catriona, K. of K., Beauty of Bute and Katie Glover have more colour, but mostly concentrated about the eyes; in others again, the colour has a wider distribution, *e.g.*, King Edward, Buchan Beauty and Fortyfold. In the last-mentioned variety the coloured areas exceed the white areas in extent.

Both whole coloured and parti-coloured varieties are subject to occasional variations. Thus Di Vernon, Catriona and Arran Victory have been known to produce white tubers. King Edward, on the other hand, may give rise to whole-coloured tubers.

White Tubers.—The great majority of commercial varieties have what are known as white skins. The term "white" is apt to be misleading, as no variety has an absolutely white skin. However, it is used commercially to include a wide range of yellow shades. Varieties may be differentiated by the shade of yellow. Most yellow-fleshed varieties, especially where the colour is highly developed, have yellow skins, *e.g.*, Duke of York, Myatt's Ashleaf and Immune Ashleaf. Other varieties have pale yellow skins, as, for example, Great Scot. The greatest number, however, have skins which are even paler than the Great Scot type. Whiteness in tubers is due to the absence of visible pigment in the cork cells. On being exposed to light and air the tubers of many white varieties develop colour, *e.g.*, Epicure, Royal Kidney, Dean, Templar and Norna. This character is especially frequent in blue-sprouted varieties and the breeder must often discard seedlings because of this fault.

Russet Tubers.—Several commercial varieties have russet skins and for that reason are very easily identified. How

exactly these types arise is not known but it a noteworthy fact that each has its white-skinned homologue.

Tuber skins may be rough or smooth, depending on the thickness of the skin. The following varieties have smooth skins—Lochar, Marquis of Bute, King Edward and Witchhill; rough-skinned varieties are Duke of York, Gregor Cups and Ally.

Position and Depth of Eyes.—The eyes are always most concentrated at the apex of the tuber. The majority may be in a cluster on the tuber point or they may be grouped some distance from the point, in which case they are said to be on the shoulder. The remainder are distributed spirally over the tuber surface, the internodes becoming greater towards the heel end. The basal internodes are usually longer in pear-shaped and oval tubers than in conical tubers. In some varieties, *e.g.*, Epicure, King George, British Queen, and Early Market there is a distinct swelling below each eye. In such cases the tuber is said to have "raised eyebrows." The eyebrow itself often affords useful assistance; in Abundance, for example, it is long, while in Arran Comrade it is short. Some varieties, Great Scot, President and Rhoderick Dhu, may be distinguished from others, such as Ally, by having more numerous eyes. Eyes may be classified as deep, medium and shallow. In the first group are found Epicure, Champion, Rocks and Fortyfold; in the second, British Queen, King George, Kerr's Pink, Rhoderick Dhu and Great Scot: and in the last, Evergood, Templar, King Edward, Witchhill and Duke of York.

Colour and Consistency of the Flesh.—As with the skin, the flesh colour is only fully developed in the mature tuber. Varieties are described as having yellow, pale yellow and white flesh. Duke of York is a good example of the first type; Bishop of the second; and Edzell Blue of the last. Some varieties, especially when immature, are characterised by the frequent development of colour in the region of the vascular cylinder of the tuber. Herd Laddie and Flourball show this trait fairly constantly. Again, the cut surface of a few types turns rapidly red brown, a feature of special importance in Majestic and due to enzyme action. The consistency of the flesh is such that some varieties may be called soft and others hard fleshed—conditions which may be determined by cutting. Generally earlies have soft flesh and lates hard flesh, but exceptions exist. Comparisons, however, must be made with mature tubers and those free from virus or other diseases. As examples of early varieties, it may be stated that Puritan, Ninetyfold and May Queen have

softer flesh than Duke of York, while amongst lates, Langworthy and Crusader have harder flesh than Majestic or Nithsdale. It should be pointed out that much practice is necessary before one can make fairly definite decisions in this way.

Type of Second Growth.—The type of second growth is frequently very helpful in determining varieties, but its occurrence is not general, being dependent on the season, and can therefore be applied only in special cases. Second growth occurs where plants have commenced to ripen and where growth has been renewed by altered weather conditions. There are several distinct forms of second growth, viz., cracking, formation of secondary tubers, protrusions from tuber eyes and prolongation of the tuber axis. Cracking is a distinct feature of Ally and Scottish Chief. The formation of secondary tubers—separated from the primary ones by a length of stolon—occurs in Up-to-Date, Northern Star, Dominion, Pathfinder and Rhoderick Dhu. Protrusions from the eyes are found in British Queen, King George and Majestic. Prolongation of the tuber axis is found often in long but seldom in round potatoes. It occurs in British Queen, King George, Puritan, Catriona and occasionally in Golden Wonder. The flesh of the prolonged portion of Golden Wonder is generally lighter coloured than that of the remaining tuber tissue.

Microscopic Characters.—The ability to produce a large percentage of superior starch grains would appear to be varietal. Johnson and Boyle* have compiled a table showing the average size of the largest and medium size grains for many commercial varieties. Shamrock and Great Scot have large average grains, while Early Rose and Royal Kidney have small average grains. It is to be noted, however, that size of grain varies with size of tuber, and tubers must be uniform to make the results comparable. In making such comparisons also it must be borne in mind that the largest grains are found generally in the tissue lying immediately adjacent to the vascular cylinder.

In a recent paper Artschwager† has shown that some varieties are characterised by having "stone cells." These are visible when sections through the region of the bud are examined microscopically. In other varieties such cells are wanting. In this connection nothing definite can be said about British varieties. Observations, however, are being made.

* "The Industrial and Nutritive Value of the Potato in Ireland." *Jour. Dept. of Agric. and Technical Instruction for Ireland*, Vol. XVIII, No. 4.

† *Journal Agric. Research*, Vol. XXVII, No. 11.

B

The Sprout.—Ripe tubers cannot be made to germinate before a certain time has elapsed. Varieties differ, however, in the period required—some, such as Early Pink Champion, May Queen, Duke of York, British Queen, Arran Chief, Rhoderick Dhu and Great Scot sprout readily, but others, including Arran Consul, Witchhill, Immune Ashleaf, Norna, Tinwald Perfection and Golden Wonder, are much slower in sprouting. The minimum temperature for germination is about 8° or 10° C. (46 or 50° F.). The cause of the resting and the processes which go on during that period are not accurately known. However, when germination begins, diastase and other enzymes are formed and the starch is converted into sugar. The latter is transferred to the growing sprout, where it is used in the formation of new tissue. The buds do not always develop equally; the most vigorous is the apical one. Apart from the rapidity of development there are distinct differences between varieties in the thickness of sprouts. Early Pink Champion, Great Scot, and America, especially the first mentioned, have thick sprouts; Evergood, King Edward, Majestic and Cardinal have thin sprouts. It has been stated recently* that within a variety the tubers with thick sprouts produce better crops than those with thin sprouts. Schander maintains† that a strong connection exists between capacity to sprout and subsequent yield; with numerous sprouts there is an increased yield. According to the same authority, the formation of sprouts in sound potatoes is dependent on the size of the tuber, *i.e.*, the number of sprouts increases with increasing size. The increase, however, is not great. In America thin sprouts have been associated with leaf roll. Such, however, has not been found to be the case in this country.

It is well known that the length of the sprout and the development of colour on it are influenced by light and moisture. In darkness long etiolated sprouts are formed on which the colour, if any, is very faint and confined to the lenticels. Moisture also appears to inhibit the development of pigment. In diffuse light the sprouts do not grow to the same extent and the colouring is much more marked, being partly green and partly red or blue purple. The green is due to the formation of chlorophyll, with which the cells underneath the colourless epidermis are filled. The red or blue colouring matter—anthocyan—is

* Snell, Dr. K., Keimungsprüfungen bei der Kartoffelknolle. *Deut. Landw. Presse.* 50, No. 7.

† *Landwirtschaftliche Jahrbücher.* Heft 3, Jan., 1924.

dissolved in the sap of the cells immediately underlying the epidermis. Chlorophyll is present also in the purple-coloured portions, but its presence is often obscured by the pigment. Even in the green parts purple is present in small quantities. The light green parts, however, contain no anthocyan. The root points are in general colourless. Grown in diffuse light, the colour of the sprout may be (1) Faint pink, *i.e.*, white or greenish-white with green tips, but generally showing a little pink, which increases at the base or at the tip on exposure. The variety, Ally, is a good example of this class (2) Pink, generally on a white or greenish-white ground, the colour at the tip being similar to the colour at the base. The greatest number of pink-sprouted varieties are to be found in this group (3) Blue or blue purple, when the tip and base are always a shade of blue. Generally the whole sprout becomes coloured. In all groups colour is always most intense at the lenticels.

In the existing schemes for the classifying of potato varieties the fundamental bases are the sprout colour, the maturity, and the tuber shape. However, during the growing season there is no sprout to examine, hence it is of importance to learn how the sprout colour may be inferred from a study of other parts of the plant. The following colour connections have been determined :—

(1) All plants having blue or blue purple predominating in the flowers have blue or blue purple sprouts.

(2) All plants having red or red purple predominating in the flowers have pink sprouts.

(3) The colour of the sprout corresponds with the colour, if any, on the tuber itself, including the scale leaves, or on the underground runners.*

These rules may not always be applicable; some varieties do not flower and others have white flowers; again, many varieties, especially earlies, have stolons on which as yet no colour has been observed. Nevertheless, as guides they are often very useful in the field.

Hairs are to be found on all normal sprouts and these have been used in separating varieties.† Sprouts may be grouped as follows :—(1)) Hairs frequent, *e.g.*, Duke of York and Arran Comrade, and (2) hairs few, *e.g.*, Great Scot and Arran Chief.

* An apparent exception to this rule is reported as occurring on a "sport" from Arran Victory.

† Davidson, W. P. "The Irish Seed Potato Trade, with some Notes on the Distinguishing Features of the Principal Varieties of Potatoes." *Jour. Dept. of Agric. and Technical Instruction for Ireland,* May, 1922.

Classification of the Tubers of some Common Potato Varieties.

1. White Tubers.

ROUND			LONG						
			OVAL			PEAR-SHAPED			CONICAL
White Flesh		Yellow Flesh	White Flesh		Yellow Flesh	White Flesh	Yellow Flesh	Pale Yellow Flesh	White Flesh
Pebble	Spherical	Spherical	Short	Long	Short				
Arran Comrade Great Scot Rhoderick Dhu *East Neuk* Burnhouse Beauty **Ally (a)** **President** **General** ***Conquest***	Epicure America Rocks Bobbie Burns	*Champion*	*Templar* * *Abundance* † Evergood * *Irish Chieftain* ‡ Up-to-Date † Tinwald Perfection † Arran Consul (*a*) ‡	Witchhill * Royal Kidney † Norna † Magnum Bonum † Majestic (*a*) ‡ *May Queen* ‡ *International Kidney* ‡	*Sharpe's Victor* *	*Langworthy* Sharpe's Express † Crusader † *Nithsdale* *	Duke of York (*a*) ‡ *Immune Ashleaf* † *Myatt's Ashleaf* † Dargill Early †	Bishop (*a*)*	British Queen ‡ King George ‡ Puritan Ninety-fold ‡ Eclipse (*a*) †

2. Red Tubers.

ROUND			LONG			
			OVAL		PEAR-SHAPED	CONICAL
White Flesh		Yellow Flesh	White Flesh		White Flesh	White Flesh
Pebble	Spherical		Short	Long		
Kerr's Pink **Flourball** **Reading Russet** **Shamrock** **Utility**	**Early Pink Champion** **Gregor Cups** **Sharpe's Pink Seedling**	Rector Lord Rosebery Yam	Arran Rose † Ardneil Rose † Crimson Beauty †	Waverley *	Red King Edward (*a*) † **Mr. Bresse*** **Cardinal** †	Early Rose ‡

3. Purple Tubers.

ROUND		LONG	
White Flesh		Pear-Shaped	
Skin Dark Purple	Skin Light Purple	White Flesh	Yellow Flesh
Edzell Blue *Arran Victory* Herd Laddie	*Eightyfold*	*Pride of Bute* ‡	*Keppleston Kidney* †

4. Parti-Coloured Tubers.

(The Skin may be White and Purple or White and Red)

	ROUND			LONG		
				Oval		Pear-Shaped
	White Flesh		Yellow Flesh	Short	Long	White Flesh
				White Flesh	Pale Yellow Flesh	
With A PURPLE	*Fortyfold* *Buchan Beauty*		*Purple Champion*		*Di Vernon* ‡ *Catriona* ‡	
With B RED	Eye Pink	Eye Red				
	Lochar Northern Star Marquis of Bute	Meins Early Round Beauty of Bute John Bull		K. of K. ‡ Katie Glover ‡		King Edward (*a*) †

5. Russet Tubers.

ROUND	LONG	
	Oval (Short)	Pear-Shaped
White Flesh	White Flesh	White Flesh
Village Blacksmith Brown Rocks	Field Marshal †	Golden Wonder †

Abbreviations:—* Thin tubers. † Tubers medium depth. ‡ Thick tubers.

Those varieties in *italics* have blue sprouts; the remainder have pink sprouts. Those varieties marked (*a*) are rather inconstant in shape

COUNCIL OF AGRICULTURE FOR ENGLAND.

THE Sixteenth Meeting of the Council was held on 21st May at the Middlesex Guildhall, Westminster. The Chairman for the year, Mr. James Donaldson, was in the Chair.

The Chairman read a letter from the Rt. Hon. Edward Wood, M.P., Minister of Agriculture, as follows :—

> "I have been honoured by a command to have an audience with His Majesty the King this morning at 11 o'clock, and I very much regret, therefore, that I shall be unable to attend the Meeting of the Council of Agriculture. Lord Bledisloe will be present and will be in a position to deal with any questions of policy which may arise in the course of your proceedings."

Statement by the Parliamentary Secretary.—*Lord Bledisloe* referred to the statement made by Mr. Wood at the last Meeting of the Council on 19th March, and said with regard to the Minister's independent consultations with the various agricultural organisations on the question of an agreed agricultural policy, that the Minister was genuinely hopeful that he might be able, with the aid of the suggestions made, to prepare an agricultural policy which would meet with a large measure of general consent. The British Sugar Subsidy Bill had received the Royal Assent and might do much to maintain arable cultivation on some of the light land in the Eastern Counties and elsewhere, and to increase employment both on farms and in factories. Three sugar factories were already at work, and it was expected that seven or eight more would be in operation before next winter. The Hop Control would cease in August, and a duty of £4 per cwt. on imported foreign hops had been imposed as part of the Budget proposals. A Bill to deal with Tithe Rentcharge on lines which it is hoped would be equitable both to tithe owners and tithe payers would shortly be introduced, as well as a Bill to deal with marking of imported agricultural produce, and also a Bill to facilitate a settlement between the Ministry and County Councils of the finance of the scheme for settling ex-Service men on the land. The Milk and Dairies Consolidation Act of 1915 would come into operation automatically on 1st September of this year, and would do so without the need of any repeal or amendment of the Act of 1922. The Tuberculosis Order of 1914 would come into operation on the same date, and a Bill was being prepared to enable the Treasury to refund to Local Authorities the same proportion of compensation in respect of the slaughter of tuberculous animals as was provided in 1914.

His Lordship added that it was not likely that any further measures relating to agriculture could be carried through this session of Parliament, though it was hoped that next year land legislation of a much more comprehensive character would be possible.

Dealing then with the question of Rural Housing, Lord Bledisloe said that the Ministry was in close touch with the Ministry of Health in the matter. There appeared to be a good prospect of cottage building in rural areas being accelerated in the early future. A great difficulty was to obtain skilled labour, and a Committee was at present considering proposals which would help in that direction. Under the Wheatley Housing Act, an increased subsidy had been provided in respect of new cottages erected in rural areas. The increased subsidy was £12 10s. for 40 years in place of £6 for 20 years under the previous Act. It was estimated that, with the aid of the Local Authorities' contribution, it should be ordinarily possible to let a house which cost £425 at about 4s. a week. 105 Rural District Councils had already adopted the scheme. A Committee of the Ministry of Health was now investigating new methods and types of house-construction. These types were being built in various centres throughout the country for demonstration purposes. County Councils were also empowered to lend money to persons desirous of altering or reconstructing old houses.

As regards the Rating of Small Holdings, the Ministry had acted on the suggestion of the Council at its last meeting and had sent a Circular Letter to Clerks of County Councils throughout England and Wales indicating means by which small holders could be assisted in getting a reduction of their assessments where they were rated on a higher level than occupiers of neighbouring land.

Another question to which the Council attached importance was a new Sheep Scab Policy. This question had been before the Agricultural Advisory Committee, and might be expected to be ready for the Council's consideration at its next Meeting.

In reply to *Mr. J. S. Gibbons* (Gloucs.), *Lord Bledisloe* said that the Ministry's Land Drainage Bill was in draft, though it was doubtful whether it could be passed during the current session. *Mr. Gibbons* also enquired as to the erection of more houses on small holdings. *Lord Bledisloe* replied that that would come under the new Small Holdings Policy to be inaugurated next year. In reply to *Mr. F. J. K. Cross* (Berks), *Sir Francis Floud* said that the present scheme

for small holdings would go on until 1st April, 1926, though it was not possible for the Ministry to authorise very much additional in the way of capital expenditure between now and that date because the funds allowed under the Act had been practically fully spent or committed. *Col. Courthope, M.P.* (East Sussex) asked whether any means had been found of extending to all really rural areas the higher scale of subsidy for housing provided by the Wheatley Act for rural parishes. *Lord Bledisloe* replied in the negative, and indicated that the definition of an "agricultural parish" in the Act would require amendment if that object was to be achieved. *Major Hotchkin* (Lindsey), *Mr. W. B. Taylor* (Norfolk), *Mr. R. W. Hall* (Hereford), *Major Fawkes* (West Riding) and *Mr. H. Dent-Brocklehurst* (Gloucs.) asked further questions in regard to Rural Housing and Unemployment Drainage Schemes.

Capt. E. T. Morris (Herts.) moved a hearty vote of thanks to the Parliamentary Secretary for his very interesting statement. This was seconded by *Mr. H. E. S. Upcher* (Norfolk), put to the meeting, and carried unanimously.

Allotments Legislation.—The Chairman of the Standing Committee (*The Rt. Hon. F. D. Acland*) moved the adoption of the Report on Allotments, which welcomed the Allotments Bill recently introduced, and trusted that the principles contained in it would be the basis of legislation in the present session of Parliament. The Report emphasised the following points as being of importance for the permanent well being of the movement:—

1. The facilitation of the provision of allotments in schemes of town planning.
2. Easy access to vacant land for allotment purposes.
3. Reasonable notice and compensation to allotment holders when quitting their plots.
4. The availability of advances from the Public Works Loan Board to to properly constituted allotment societies for the purpose of purchasing allotment land.
5. The simplification of arbitration proceedings in cases where compensation has to be paid in taking allotment land.
6. The direct representation of allotment holders on allotment committees, and direct access for the reports of such committees to the Councils of Local Authorities.

Sir Douglas Newton supported the motion. *The Chairman* said that it might be helpful to the Government if the Council added a suggestion that the present Bill should be made a Government Bill. This suggestion was agreed, and the Report adopted.

Swine Erysipelas.—*Mr. Acland*, on behalf of the Standing Committee, moved the adoption of its Report on this subject, which was carried.

Co-operative Marketing of Co-operative Produce.—*Mr. Acland*, on behalf of the Standing Committee, moved the adoption of its Report which called attention to the publication recently issued on this subject by the Ministry. *Mr. Hawk* (Cornwall) enquired whether the Ministry could assist Counties which were organising a central station for the grading, marking and marketing of agricultural produce. *Lord Bledisloe* said that for successful co-operation the initiation must come from the farmers, and the less Government intervention as a general rule the better. Still, the Ministry could assist certain co-operative schemes financially and would do their utmost within the limits of those powers.

Special Committee on Agricultural Policy.—*Mr. Acland*, on behalf of the Standing Committee, moved :—

> "That in view of the Minister's invitation to the Council of Agriculture to submit proposals for consideration as to a future Agricultural Policy, the Council should appoint a Special Committee to draw up proposals for submission to the Council."

He referred to the Memorandum, which had been circulated with the Agenda, setting out alternative methods proposed by the Standing Committee :—

> 1. That the Chairman and Ex-Chairmen of the Council (Lord Selborne, Sir Douglas Newton, Mr. George Edwards and Mr. Donaldson) be asked to be members of the Committee and to co-opt not exceeding seven other members to complete the Committee, and
>
> 2. That nominations be now made from the Council for a Committee of eleven persons; if more than eleven are nominated, a ballot to be taken.

He said that the Council would no doubt first of all decide as to whether the Standing Committee was right in suggesting that a Committee should be formed to discuss policy, and then signify which of the two alternatives, or if neither of them, what other alternative plan should be adopted for setting up that Committee. *Mr. Rea* (Northumberland) seconded the Resolution, but suggested that the alternative methods of setting up the Committee should be merged, so that the four gentlemen should be members of a Committee, the others of which should be chosen by the Council. *The Chairman* first put the resolution, which was carried unanimously. *Mr. Bruford* (Somerset) seconded Mr. Rea's proposal. *Mr. Woodhead* moved as an amendment that the first alternative suggested by the Standing Committee should be adopted. *Mr. H. W. Thomas* (Hants.)

seconded. *Sir Merrik Burrell* (West Sussex) supported. *Mr. Hawk* suggested a compromise. *Mr. Spraggon* (Durham) asked whether it was necessary that persons to be co-opted should be members of the Council. *The Chairman* replied that they should. Mr. Woodhead's amendment was then put to the meeting and carried.

Joint Animal Diseases Committee in each County.—*Sir Merrik Burrell* moved :—

> "That this Council regrets that Capt. Pretyman's Committee in their recent report on Foot-and-Mouth Disease should have departed from the recommendation of the former Committee that there should be only one Committee in any one geographical County for certain objects in connection with animal diseases, that Committee to consist of representatives from County Councils, County Boroughs and Boroughs within the area of any one County. The Council attaches great importance to having only one authority for Diseases of Animals administration in each County, and therefore reaffirms its resolution of 22nd February, 1924."

Mr. Hamilton (Lancs.), *Mr. George Nicholls* (Soke of Peterborough), and *Lord Bledisloe* discussed the matter, and His Lordship said that a draft Bill, more or less on the lines of Sir Merrik Burrell's resolution, had been prepared by the Ministry and was now under consideration by the County Councils' Association and the Association of Municipal Corporations. The resolution was put and carried unanimously.

Imported Superphosphates.—*The Rt. Hon. Lord Strachie* moved :—

> "That this Council is opposed to the application of the Fertilisers Manufacturers Association for the imposition of a duty upon imported superphosphate."

Mr. R. G. Patterson (Staffs.) seconded. *Mr. Geo. Edwards* and *Mr. Haman Porter* supported the resolution and *Col. Courthope* and *Mr. H. W. Thomas* opposed it. The resolution was then put to the meeting and carried.

Somersetshire Teart Lands.—*Lord Strachie* moved:—

> "That the Minister of Agriculture be requested to make experiments in connection with the feeding of animals on teart or scouring lands."

He stated that the Somersetshire Agricultural Committee was anxious to know what progress had been made in the experiments which the Ministry had already arranged, and that, in the view of that Committee, future experiments should not be confined to hay from teart land. *Mr. Hamilton* seconded the Resolution, which was carried unanimously. *Lord Bledisloe* said that the Ministry was not yet in a position to say whether the disease was a specific disease, or whether the effects were due to some form

of malnutrition caused by the herbage or the quality of the soil of teart land. The question was one in which the Bristol University College, as the advisory centre for the district, might be useful in carrying forward further investigations on the land itself.

Rural Housing.—*The Rt. Hon. F. D. Acland* moved:—

> "That in order to encourage Rural District Councils to use their powers under the Housing (Financial Provisions) Act of last year, the Council of Agriculture would welcome increased assistance being offered from the Exchequer to those Councils which have used their powers under this Act to assist the building of cottages to the extent of a penny rate, so that in respect of further cottages, the subsidy required from the rates would be halved."

He drew attention to the Memorandum from the Standing Committee which accompanied the resolution, in which the finance of rural housing under the Wheatley Act was carefully explained. The resolution was duly seconded and was spoken to by *Mr. A. R. White* (Wilts.), *Capt. Morris*, *Mr. Spraggon*, *Mr. Rea*, *Mr. Upcher*, *Mr. H. C. Gardner* (Worcs.), and *Sir Merrik Burrell* and put to the meeting and carried unanimously.

Dominion Foodstuffs in Great Britain.—*Lord Strachie* moved:—

> "That this Council is opposed to the granting of £1,000,000 yearly to the Dominions to enable them to assist the marketing of their food products in Great Britain to the detriment of the British Farmer."

Mr. Hamilton seconded the resolution. *The Rt. Hon. Edward Wood, M.P.*, Minister of Agriculture, said that it was not to be assumed that the grant in question must necessarily involve damage to the British Producer. This country had to import a certain amount of its supplies from abroad and the object was to endeavour, within that amount, to substitute Dominion goods for Foreign goods. In the debate in the House of Commons last December, the Prime Minister had said:—

> "I want to repeat once more that it is the hope of the Government that this money could be used to enable the Dominions to secure a larger share of that part of the Home market which has to be supplied by importation from abroad. The Dominions have always recognised that our home producers have, and always should have, the first place in the Home market, but they ask, and we think rightly ask, that they should have a preference over foreign countries as regards that part of the Home market which cannot be supplied by the home producer."

The Chancellor of the Exchequer in the same debate said:—

> "Great care will have to be taken in the administration of this policy to make quite sure that we do not in so doing do an injustice to our own domestic agricultural producers. We wish to encourage the Empire

products at the expense of the foreign product, but not at the expense of the domestic producer."

No expenditure under this head could be incurred until the necessary vote had been passed by the House of Commons and proposals would first have to be considered by the Imperial Economic Committee and the Cabinet. In view of the Minister's speech, *Lord Strachie* said he would ask the Council's permission to withdraw his motion and substitute a motion in the following sense:—

"That this Council is not opposed to the granting of one million pounds a year for marketing Colonial produce in this country, provided that the British producer is not undersold in the British Market in consequence of that grant."

Sir Douglas Newton seconded and *Mr. Ashby* moved an amendment as follows:—

"That this Council is of opinion that whatever sum may be provided by the Imperial Government for the improvement of marketing of Empire produce should be devoted proportionately to the improvement of marketing of British and Dominions produce."

Mr. Matthews (Hereford) seconded, *Mr. Christopher Turnor, Mr. Hamilton, Mr. Dallas, Mr. Spraggon, Mr. Bruford, Mr. Rea* and *Mr. Patterson* spoke on the matter and *Mr. Rea* gave notice of a further amendment as follows:—

"That this question be referred to the Committee on Agricultural Policy that has been formed, with a request that they give it special consideration in their Report to be presented to the next meeting of this Council."

Mr. Geo. Edwards seconded this amendment.

Mr. Ashby's amendment was first put to the meeting and carried. It then became the substantive resolution on which *Mr. Rea's* amendment was proposed. Mr. Rea's amendment was then put to the meeting and carried.

County Fees for Certain Certificates.—*Mr. R. W. Hall* moved:—

"That the question of fees for certificates under the Rent Restriction Act and the Agricultural Holdings Act, 1923, be referred to the Standing Committee to consider whether a general recommendation ought not to be made for uniformity in such fees in all Counties, and report to this Council at its next meeting."

Mr. Gardner seconded, and the resolution was put to the meeting and carried.

Report from Agricultural Advisory Committee.—*Mr. Dallas* moved the adoption of the Report (No. 10) of the Proceedings of the Agricultural Advisory Committee in England and Wales which was put to the meeting and carried.

AGRICULTURAL ADVISORY COMMITTEE FOR ENGLAND AND WALES.

REPORT (No. 10) to the Councils of Agriculture for England and Wales on the Proceedings of the Agricultural Advisory Committee:—The present report covers the proceedings at three meetings, namely those of 4th March, 1st April, and 6th May.

At the first of these meetings the news was brought to the Committee of the death of one of their colleagues, Mr. John Roberts, a representative from the Council of Agriculture for Wales. The Committee expressed their deep regret and instructed that a message of sympathy and condolence be sent to the family.

(1) **Agricultural Conference.**—At the meeting on the 4th March, the Committee was informed of the announcement, then recently made, by the Minister in regard to his alternative that representatives of the three sections of Agriculture should be consulted separately with a view to the formulation of an agreed policy which might be acceptable to successive Governments.

(2) **Register of Movements of Live Stock.**—A preliminary draft Order was considered by the Committee providing for a Register of Movement of Live Stock which it had been suggested would be useful for tracing animals in outbreaks of Foot-and-Mouth Disease The Committee considered that it would be very difficult to bring into such a Register the ordinary dealer in live stock unless he were licensed, and they were not in favour of proceeding with the draft Order until this difficulty had been overcome.

(3) **Tuberculosis Order.**—It was reported to the Committee that the Government had decided that the financial terms contemplated in connection with the Tuberculosis Order of 1914 should be revived. This involved the Exchequer finding 75 per cent. of the compensation paid for slaughter in cases of advanced tuberculosis. It was intended that a Bill should be introduced into Parliament and the revived Order brought into operation under it at the same time as the postponed Milk and Dairies Act of 1915 was put into force.

(4) **Merchandise Marks Bill.**—The Committee was consulted in regard to the Government proposals to adopt the Merchandise

Marks Bill, under which certain kinds of imported produce, including chilled meat, frozen meat and fresh meat, bacon, hams, eggs, cheese, and honey were proposed to be marked with the name of the country of origin. The Committee suggested that poultry might be included.

(5) **Sugar Beet Research.**—The question was raised of the possibility of finding Government assistance for Sugar Beet Research. On behalf of the Ministry, certain difficulties in the matter were pointed out, and it was stated to be doubtful whether the industry was as yet in a stage to make it worth while to go to any large expense in research. A Sugar Beet Plant Research Institute would be costly, and similar Institutes on the Continent at the present time were the outcome of 60 years of steady investigation and improvement. The Ministry would, however, carefully consider the question.

(6) **Land Drainage Bill.**—The preliminary draft of a Land Drainage Bill was considered by the Committee at its meeting on 1st April. This Bill proposed to transfer certain existing powers from the Ministry to the Local Authorities, and also to give power to County Coucils to compel an owner whose default or omission in not cleaning his drains and ditches was holding up water, to get the work done, or for the Local Authority to proceed with it at the cost of the owner. The Committee pointed out that undue responsibilities might devolve upon riparian owners for he upkeep of banks above tidal waters, and asked that further consideration might be given to the point.

At the next meeting on the 6th May, the Ministry brought forward proposals for extending the right of appeal by riparian owners in those cases where others unrated or uncharged might benefit by the drainage works required to be done under the particular clause under discussion at the previous meeting. The Committee agreed that the draft Bill, amended to safeguard riparian owners in this way, might be approved.

(7) **Foot-and-Mouth Disease.**—The Chief Veterinary Officer reported on 1st April that there were then only three scheduled areas remaining, namely, in Cheshire, in the Isle of Wight and in Sheffield. The Cheshire outbreak was due to a case of concealment of disease, and the farmer had been prosecuted and fined £88 and costs. The question was raised as to whether it was a right and proper thing for compensation to be paid to

such an owner for the slaughtering of diseased stock, and the Committee was informed that the matter had been considered and would be again looked into.

(8) **Foot-and-Mouth Disease Committee's Report.**—The Report was circulated for the information of members of the Committee. The Committee drew attention to paragraph 171 of the Report, which stated the view that the idea of a Joint control of animal disease was hardly possible of attainment, and should therefore be abandoned. The Advisory Committee, however, after consideration of the matter were not in agreement with this view.

(9) **Local Authorities Regulations under Foot-and-Mouth Disease Order, 1895.**—The terms of a draft Order which the Ministry proposed to make requiring Local Authorities to submit Orders regulating the movement of cattle in their counties to the Ministry for approval before issue were agreed.

(10) **Draft Imported Animals Order.**—The Committee also approved the draft of an Order which provided that an occupier or person in charge of premises where imported animals are brought under licence for detention should give the Ministry's or the Local Authority's Inspector all reasonable assistance and facilities for the examination of the animals in order to ascertain whether they had been marked in accordance with the Act or the Ministry's Order as to tagging.

(11) **Sheep Scab.**—At the meeting of the 6th May, the outlines of the proposed policy of eradication in the case of sheep scab were placed before the Committee, and it was agreed that a draft Order embodying them should be circulated to the members for consideration and discussion at a later meeting.

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JUNE ON THE FARM.

J. R. Bond, M.B.E., M.Sc., N.D.A. (Hons.),
Agricultural Organiser for Derbyshire.

Arable Land.—In the northern counties the swede crop is sown during May and land that cannot be got ready before June is drilled with common turnips. In the southern and some of the midland counties, swedes sown before June are liable to

become "mildewed" later in the summer, as a result of which the crop loses its leaf and suffers considerably in yield. Mildew is a term commonly applied to both the white mould and the grey aphis forms of infestation, but both pests appear to be associated with a check in the growth of the crop, lack of moisture generally being the chief trouble. Common turnips and certain varieties of swede, for instance Eclipse Purple Top, are not so susceptible to the white mould form of mildew as are Bangholm and certain other varieties. As regards the aphis, dry spraying with a dust containing 5 per cent. of nicotine sulphate has been found to be effective in American trials. The same treatment might also be expected to reduce depredations of the black aphis or "smother fly," which often attacks mangolds.

June is regarded as a good time for sowing grass and clover seeds under cover of rape on land that has received a half fallow. On hill farms where sheep are kept, outlying fields can be kept in fair condition without yard manure and root growing, if artificial manures are applied liberally to the rape crop and this is fed off with sheep. Indeed, with the help of phosphates and wild white clover, a rich clovery sward is obtained, which when ploughed under will supply all the nutriment required by two corn crops. Charlock, however, may introduce difficulties in this method of management.

With a view to making an early start with the hay harvest, farmers like to make rapid progress in June with the work of cleaning and singling the root crops. Moreover, early cleaning and singling is an important factor in the growth of good crops of roots. The damage done by weeds and surplus plants is not limited to their shading effect; they compete with the crop plants for plant food and moisture. All young plants are voracious feeders, gathering food in anticipation as it were of future needs, and many weeds send down their roots more quickly than the crop plants among which they grow. Side-hoeing by hand is both expensive and slow, yet many farmers do not make use of the special devices which are available for this operation, and in consequence their root crops are grown at greater cost and trouble than is necessary.

Thistles.—Two species of thistle have been scheduled as Noxious Weeds, which it is the duty of County Agricultural Committees to control by means of notices served on the occupiers of land on which these weeds are permitted to grow unchecked. The Spear Thistle (*Carduus lanceolata*) is a common

weed of pastures, but, not having underground runners, its eradication is only a matter of preventing seeding. The Creeping Thistle, however, is very persistent and spreads both by seeding and by means of underground runners. Pulling is the best way of checking it amongst corn, and the aim should be to extract as long a piece of root as possible. If merely spudded, especially if spudded early in the season, two or more thistle shoots may appear in place of the one that was cut off. In pasture land the common practice of mowing creeping thistles once a year does little towards reducing their numbers; it does prevent the blowing of thistle down, however, if the mowing is done early enough; but it is futile to mow after all other work has had attention and the thistles have flowered. Cutting twice, or better three times, in the season, beginning while the first shoots are only about 4 to 6 inches high, as they are in June, is the most effective method so far discovered for dealing with this pest. Trials which brought out the effectiveness of repeated cutting were carried out at the Harper Adams College in 1907—1910 and again at Cockle Park in 1917—1920. The treatment has to be continued over two and if necessary three seasons to ensure complete eradication, and it is important that the first cutting of the season should be done while the plants are small. Meadows are rarely infested with thistles, and shutting a field up for hay two years in succession is a good method of getting rid of not only thistles but also a number of other weeds which infest pasture land.

Quality of Milk.—While experiments generally reveal only small differences in the composition of milk yielded by cows receiving different rations, averages of large numbers of samples show that the fat content of milk is appreciably lower while the cows are out at grass than while they are indoors. The following figures represent the average of 714 samples taken by the Derbyshire Official Sampler and analysed by the County Analyst during the year 1924 :—

Quarter ended—	Fat. Per cent.	Non-fatty Solids. Per cent.	Total Solids. Per cent.
March ...	3.73	8.73	12.46
June ...	3.59	8.79	12.38
September	3.54	8.76	12.30
December	3.99	8.80	12.79
Average for year ...	3.72	8.77	12.49

During June of last year, two cases came to notice in which the mixed milk of the herds contained less than 3 per cent. of

fat. In both cases the farmers were endeavouring to correct the trouble by inducing the cows to consume large quantities of cake, but without beneficial effect. Individual samples showed that certain cows were yielding very poor milk. By milking these very early in the morning and after the rest of the herd in the evening and by paying special attention to clean stripping, and probably as a natural improvement with advance of lactation. the trouble was gradually overcome.

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MONTHLY NOTES ON FEEDING STUFFS.

E. T. HALNAN, M.A., Dip. Agric. (Cantab.),
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The Nutritive Ratio of Feeding Stuffs.—The nutritive ratio, or as it was formerly called, the albuminoid ratio, of feeding stuffs, is of value to the stock feeder, since it helps him to classify feeding stuffs according to their relative richness in protein. This is important, since the aim of the stock feeder is so to compound his ration that the mixture fed contains the requisite amount of protein blended with the right amount of energy producing foodstuffs. The amounts of protein and energy required by animals vary according to the age of the animal, and the purposes for which the animal is designed. Thus, the nutritive ratio of the ration of a cow being fattened for slaughter should differ considerably from that required for a cow intended for milk. It is, therefore, very important that all stock feeders should be able to work out for themselves the exact nutritive ratio of a mixture of feeding stuffs. Simple though such an operation appears at first sight, it is not so, and many feeders, often unconsciously, make mistakes in working out the nutritive ratio of a ration. Particularly is this the case with poultry keepers, who normally feed the ration to poultry in two distinct mixtures, a grain feed generally alternating with a mash feed.

There are two methods available in calculating the nutritive ratio of a ration. The first, or long method, is rather a tedious operation. The nutritive ratio of the ration is arrived at by adding to the percentage of digestible carbohydrates and fibre the percentage of digestible oil multiplied by 2.3, and dividing the resultant sum by the percentage of crude protein present. Thus, in the case, say, of a pig feed consisting of 60 per cent. maize meal, 25 per cent. barley meal, 10 per cent. middlings, and 5 per cent. fish meal, the result would involve the following calculation :—

	Composition digestible ingredients.			Total ingredients.		
	Protein	Fat	Carbs. and Fibre	Prot.	Oil	Carbs. and Fibre.
60 lb. Maize meal ..	7.1	3.9	67.0	.071 × 60	2.3 × 0.39 × 60	60 × .67
25 lb. Barley meal ...	6.5	1.2	64.7	.065 × 25	2.3 × 0.12 × 25	25 × .617
10 lb. Middlings ...	13.2	1.5	49.2	.132 × 10	2.3 × .045 × 10	10 × 492
5 lb. Fish meal ...	50.0	4.2	—	.5 × 5	2.3 × .012 × 5	—
Total ingredients of ration in lb. ...				9.7	7.59	61.3

$$\therefore \text{ Nutritive Ratio} = \frac{68.89}{9.7} = 1 : 7 \text{ approx.}$$

The arithmetical calculations, which it will be seen are somewhat prolonged, have been left out, the totals only being given.

By the short method of calculating the nutritive ratio advantage is taken of the fact that tables of analyses generally give the nutritive ratios of the individual feeding stuffs. For the purpose of the calculation, all one requires is a knowledge of the total digestible crude protein and the nutritive ratio. By multiplying the digestible crude protein by the nutritive ratio the sum of the carbs. + fibre + oil × 2.3 is obtained. Thus:—

	Digestible Nutrients		Total ingredients	
	Prot.	N. Ratio.	Prot.	Oil × 2.3 + Carbs. × Fibre
60 lb. Maize meal ...	7.1	1 : 11	.071 × 60	.071 × 60 × 11
25 lb. Barley meal...	6.5	1 : 10	.065 × 25	.065 × 25 × 10
10 lb. Middlings ...	13.2	1 : 5	.132 × 10	.132 × 10 × 5
5 lb. Fish meal ...	50.0	1 : 0 2	.5 × 5	.5 × 5 × .2
Total ingredients			9.7	67.21

$$\therefore \text{ N. Ratio} = \frac{67.21}{9.7} = 1 : 7 \text{ approx.}$$

We thus arrive at the same result, having considerably reduced the arithmetic.

A common mistake in calculation is to ignore the actual amounts of digestible protein present, and to calculate the nutritive ratio of the ration from the nutritive ratios only of the individual foods. This leads to serious error, as will be evidenced if we take the example given above. Thus:—

	N. Ratio.	Total ingredients Prot.	Oil × 2.3 + Carbs. + Fibre
60 lb. Maize meal ...	1 : 11	60	660
25 lb. Barley meal ...	1 : 10	25	250
10 lb. Middlings ...	1 : 5	10	50
5 lb. Fish meal ...	1 : 0.2	5	1
		100	961

$$\therefore \text{ N. Ratio} = \frac{961}{100} = 9.61 \text{ instead of } 7.$$

A similar mistake can be made by poultry keepers in neglecting the actual digestible protein present in the mash and grain

DESCRIPTION.	Price per Qr. s. d.	lb.	Price per Cwt. s. d.	Price per Ton. £ s	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv. s.	Price per lb. Starch Equiv. d.	Per cent of Digest. Crude Protein %
Wheat, British	—	—	12 8	12 13	0 16	11 17	71·6	3/4	1·78	10·2
Barley, British Feeding	—	—	10 0	10 0	0 12	9 8	71	2/8	1·43	6·5
" Canadian :—										
No. 3 Western	—	—	—		—	—	—	—	—	—
" 4 "	37/9	400	10 7	10 12	0 12	10 0	71	2/10	1·52	6·5
" American	37/9	"	10 7	10 12	0 12	10 0	71	2/10	1·52	6·5
" Danubian	37/9	"	10 7	10 12	0 12	10 0	71	2/10	1·52	6·5
" Karachi	37/9	"	10 7	10 12	0 12	10 0	71	2/10	1·52	6·5
Oats, English, White	—	—	10 4	10 7	0 13	9 14	59·5	3/3	1·74	8·0
" " Black and Grey	—	—	10 0	10 0	0 13	9 7	59·5	3/2	1·70	8·0
" Scotch, white	—	—	—	—		—	—	—	—	—
" Canadian :—										
No. 2 Western	31/3	320	10 11	10 18	0 13	10 5	59·5	3/5	1·83	8·0
Argentine	27/3	"	9 6	9 10	0 13	8 17	59·5	3/0	1·61	8·0
Chilian	28/9	"	10 1	10 2	0 13	9 9	59·5	3/2	1·70	8.0
Maize, Argentine	44/6	480	10 5	10 8	0 13	9 15	81	2/5	1·29	7·1
" Australian	44/6	"	10 5	10 8	0 13	9 15	81	2/5	1·29	7·1
Beans, English Winter	—	—	10 9	10 15	1 12	9 3	67	2/9	1·17	20·1
" Chinese "	—	—	11 6	11 10	1 12	9 18	67	2/11	1·56	20·1
Peas, English Maple	—	—	11 4	11 7	1 8	9 19	69	2/11	1·56	19·4
" Japanese	—	—	23 0	23 0†	1 8	21 12	69	6/3	3·35	19·4
Rye, Homegrown	—	—	11 0	11 0	0 16	10 4	71·6	2/10	1·52	9·6
Dari, Egyptian	—	—	10 6	10 10	0 15	9 15	75·2	2/7	1·38	7·7
" Persian	—	—	11 3	11 5	0 15	10 10	75·2	2/10	1·52	7·7
Millers' Offals :—										
Bran, British	—	—	—	7 10	1 7	6 3	45	2/9	1·47	10·9
" Broad	—	—	—	8 17	1 7	7 10	45	3/4	1·78	10·9
Middlings—										
Fine Imported	—	—	—	9 7	1 2	8 5	72	2/4	1·25	12·6
Coarse, British	—	—	—	8 7	1 2	7 5	64	2/3	1·20	11·5
Pollards, Imported	—	—		7 10	1 7	6 3	60	2/0	1·07	11·6
Meal, Barley	—	—		12 0	0 12	11 8	71	3 2	1·70	6·5
" Maize	—	—		10 15	0 13	10 2	81	2/6	1·34	7·1
" " South African	—	—		9 12†	0 13	8 19	81	2/2	1·16	7·1
" " Germ	—	—		9 7	0 19	8 8	85·3	1/11	1·03	18·4
" " Gluten Feed	—	—	—	10 5	1 7	8 18	75·6	2/4	1·25	20·0
" Locust Bean	—	—	—	9 15	0 9	9 6	71·4	2/7	1·38	4·0
" Bean	—	—	—	13 0	1 12	11 8	67	3/5	1·83	20·1
" Fish	—	—		20 10	4 7	16 3	53	6/1	3·26	50·0
Linseed	—	—		22 7	1 11	20 16	119	3/6	1·87	19·4
" Cake, English 12% Oil	—	—		13 17	1 18	11 19	74	3/3	1·74	25·3
" " 10% Oil	—	—		13 0	1 18	11 2	74	3/0	1·61	25·3
" " 9% Oil	—	—	—	12 17	1 18	10 19	74	3/0	1·61	25·3
Soya Bean " 6% Oil	—	—	—	11 5	2 14	8 11	69	2/6	1·34	38·2
Cottonseed Cake, English 5½% Oil	—	—	—	8 7	1 15	6 12	42	3/1	1·65	17·6
" " Egyptian 5½% Oil	—	—	—	8 0	1 15	6 5	42	3 0	1·61	17·6
Decorticated Cotton Seed Meal 7% Oil	—	—	—	11 7	2 14	8 13	74	2/4	1·25	36.3
Ground Nut Cake 7% Oil	—	—	—	9 10*	1 16	7 14	56·8	2/8	1·43	42·0
Palm Kernel Cake 6% Oil	—	—		7 15†	1 3	6 12	75	1/9	0·94	17·1
" " Meal 2% Oil	—	—		8 0	1 4	6 16	71·3	1/11	1·03	17·1
Feeding Treacle	—	—	—	7 2	0 8	6 14	51	2/8	1·43	1·1
Brewers' Grains :—										
Dried Ale	—	—		7 7	1 4	6 3	49	2/6	1·34	14·0
" Porter	—	—		6 17	1 4	5 13	49	2/4	1·25	14·0
Wet Ale	—	—		1 1	0 9	0 12	15	–/10	0·45	4.8
" Porter	—	—	—	0 15	0 9	0 6	15	–/5	0 23	4·8
Malt Culms	—	—	—	8 5†	1 14	6 11	43	3/1	1·65	19·9

† At Liverpool. * At Hull.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of April and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 3s. per ton. The food value per ton is therefore £8 17s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices:—N, 13s.; P_2O_5, 4s. 2d. K_2O, 2s. 6d.

mixtures respectively, even though the nutritive ratio of the grain and mash mixture has already been worked out correctly. Thus, take a mash mixture consisting of 4 parts bran, 2 middlings, 1 part Sussex ground oats, 1 part maize meal, 1 part fish meal. The nutritive ratio of this mixture works out at 1 : 3.1, and every lb. of the mixture contains .15 lb. digestible protein. Similarly a grain mixture consisting of 1 lb. oats, 1 lb. maize, 1 lb. wheat has a nutritive ratio of 1 : 8.1, and every lb. of the mixture contains .084 lb. digestible protein.

If equal quantities of the mash and grain are fed, the true nutritive ratio will be as follows:—

	Dig Prot.	N. Ratio.	Dig. Prot.	Oil × 2.3 + Carbs.
Mash ...	.15	1 : 3.1	.15	.15 × 3 1 = .465
Grain ...	.084	1 : 8.1	.081	.081 × 8.1 = .680
	Total ingredients		.231	1.145

$$\therefore \text{N. Ratio} = \frac{1.145}{.231} = 1 : 4.9$$

If the actual digestible protein present in every lb. of the mash and grain mixture is ignored the following conclusion will be arrived at:—

	N. Ratio.	Dig. Prot.	Oil × 2.3 + Carbs.
Mash ...	1 : 3 1	1	3.1
Grain ...	1 : 8.1	1	8.1
Total ingredients		2	11.2

$$\therefore \text{N. Ratio} = \frac{11.2}{2} = 1 : 5.6 \text{ instead of } 1 : 4.6.$$

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FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat	1·29	2 5	71·6	8 7	0 16	9 3
Oats	1·29	2 5	59·5	7 4	0 13	7 17
Barley	1·29	2 5	71·0	8 12	0 12	9 4
Potatoes	1·29	2 5	18·0	2 4	0 4	2 8
Swedes	1·29	2 5	7·0	0 17	0 2	0 19
Mangolds	1·29	2 5	6·0	0 15	0 3	0 18
Beans	1·29	2 5	67·0	8 2	1 12	9 14
Good Meadow Hay	1·34	2 6	31·0	3 18	0 14	4 12
Good Oat Straw	1·34	2 6	17·0	2 3	0 7	2 10
Good Clover Hay	1·34	2 6	32·0	4 0	1 0	5 0
Vetch and Oat Silage	1·34	2 6	14·0	1 15	0 7	2 2
Barley Straw	1·34	2 6	19·5	2 9	0 6	2 15
Wheat Straw	1·34	2 6	11·0	1 8	0 4	1 12
Bean Straw	1·34	2 6	19·0	2 8	0 9	2 17

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	Average Price per ton during week ending May 13th. Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	13.12	13.15	12.15	12.17	16. 7
„ „ Lime (N. 13 per cent.)	...	12.10	...	12.12	19. 5
Sulphate of Ammonia, ordinary (N.20.7 per cent.)	13.11*	13.11*	13.11*	13.11*	(N)13.1
„ „ „ neutral (N. 21.1 per cent.)	14.14*	14.14*	14.14*	14 14*	(N)13.11
French Kainit (Pot. 20 per cent.)	3. 2	3. 0	...	2.15	2. 9
„ „ (Pot. 14 per cent.)	2.17	2.15	2. 5	2.10	3. 7
Potash Salts (Pot. 30 per cent.)	...	...	3.15	3.15	2. 6
„ „ (Pot. 20 per cent.)	...	..	2.10	2.12	2. 7
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7.10	7. 2	7. 5	2.11
Sulphate of Potash (Pot. 48 per cent.) ...	12.10	11.15	11. 5	11.10	4. 9
Basic Slag (T.P. 30 per cent.)	...	...	2.12§	...	...
„ „ (T.P. 28 per cent.)	...	2. 1‡	...	...	...
„ „ (T.P. 26 per cent.)	...	1.14‡	...	...	...
„ „ (T.P. 24 per cent.)	...	1.11‡	2. 0§	...	...
Superphosphate (S.P. 35 per cent.) ...	...	...	3.15	3. 8	1.11
„ (S.P. 30 per cent.) ...	3. 7	3. 2	3. 8	3. 2	2. 1
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	9. 0	8. 0	8.10	8. 0	...
Steamed Bone Flour (N. ¾, T.P. 60 per cent.)	6. 7†	6.12†	6.10	5.17†	...
Fish Guano (N. 7½-8½, T.P. 16-20 per cent.)	...	...	13. 0	...	...
„ „ (N. 9, T.P. 10 per cent.) ..	...	...	...	12. 5	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station. London prices are for 1-ton lots. ‡ F.o.r. Works.

§ Prices include cost of carriage from works to town named, and at London are for not less than 4-ton lots. Cost to purchasers in other districts will be greater or less according to the distances of different purchasers from the works.

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MISCELLANEOUS NOTES.

Coccidiosis of Chickens.

COCCIDIOSIS is caused by the multiplication of a small animal parasite (*Eimeria tenella*) in the tissues of the intestines. This disease, which is second only in importance to bacillary white diarrhœa, is found in every species of bird, both domesticated and wild. It is particularly prevalent among chicks and turkey poults and causes very heavy losses.

The parasite has a very complicated life cycle and reproduces both sexually and by division into segments. At one period of its life it is able to live for a long time on the ground and is

very resistant to disinfectants, and for this reason the eradication of the disease from poultry farms is difficult.

Two forms of the disease occur, an acute form in chickens, and a chronic form in adult birds.

The acute form attacks chickens from 10 days to 2 months old. The younger the chicks the greater is the mortality, which in closely confined flocks kept under bad sanitary conditions may reach 100 per cent. The symptoms shown are not characteristic of the disease and are very similar to those seen in bacillary white diarrhœa. When a heavy mortality occurs in a hatch *after* the 10th day it points strongly to coccidiosis. The disease cannot be diagonised either by the symptoms observed during life or by the naked eye appearances of the internal organs seen at post-mortem examination. A definite diagnosis can be made only on finding the parasite by a microscopical examination of the contents of the intestines. In adult birds the disease occurs in a chronic form and is usually the sequel of an acute attack as chicks. The affected bird harbours the parasites which are passed out in the fæces in great numbers, the ground and food become contaminated and from these sources chickens pick up the disease.

Attempts at treatment have not given very satisfactory results. Crude catechu, in the drinking water, is the most effective method. It is given in the proportion of one-third teaspoonful to a gallon of water.

It may be laid down as a general principle for the contagious diseases of poultry that the value of a fowl is too small to pay for the time and labour expended on individual treatment. The aim of every poultry keeper must be the prevention and not the cure of contagious disease. Use high, well-drained, clean land for rearing young stock, and avoid overcrowding; keep all appliances thoroughly clean; supply clean water in troughs in which it cannot be contaminated by droppings.

All newly purchased birds should be isolated for one month and observed frequently during that period before introduction to the healthy flock. Chickens under three months old should not be allowed in contact with adult fowls.

When coccidiosis occurs the affected birds and those in contact with them should not be moved to fresh ground. If the outbreak is not widespread it is probably best to destroy the survivors and disinfect the houses and runs. Contaminated runs should be treated with quicklime, dug up and re-limed and left vacant for one year. When this is not practicable the

runs should be sprayed with 5 per cent. commercial sulphuric acid and left vacant for 14 days. This method is effective against the parasite but has the disadvantage of destroying all vegetation.

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Farm Workers' Minimum Wages.

MEETINGS of the Agricultural Wages Board were held on 21st April and 5th May at Gwydyr House Annexe, Whitehall, S.W.1, Mr. J. Willmot, P.P.S.I., acting as Chairman in the absence of Lord Kenyon. The Board considered notifications from various Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and proceeded to make the following Orders carrying out the Committees' decisions:—

Berkshire.—From 27th April to 30th September, 1925, minimum rates of wages for female workers under 19 years of age, the rate in the case of workers aged 18 to 19 being 4½d. per hr. (Rates for female workers over 19 are already in operation.)

Cumberland and Westmorland.—Minimum and overtime rates of wages for male workers and minimum rates of wages for female workers from 31st May (when the present Order expires) to 22nd May, 1926. The new Order provides for an increase of 1s. per week in the wages of workers hired on half-yearly or yearly engagements, and in the case of other male workers, an increase of 1s. per week in winter and 2s. 6d. per week in summer. The rates in the case of male workers aged 21 and over will become, in the case of workers hired on half-yearly or yearly engagements 38s. per week of customary hours (62 hr.), and in that of other male workers (other than casual workers) 31s. per week of 48 hr. in winter (1st November to the last day of February) and 32s. 6d. per week of 54 hr. in summer (remainder of the year).

The Order also provides that wages for adult male workers in casual employment shall be 8d. per hr., and that the minimum wage for female workers aged 18 and over should be 5½d. per hr.

Derbyshire.—Minimum and overtime rates of wages for female workers from 11th May to 15th December, 1925, the minimum rate in the case of such workers aged 18 and over being 5d. per hr., with overtime at 8d. per hr. for employment on Sundays.

Dorset.—Special overtime rates of wages for employment on the hay and corn harvests in the present year, the rate in the case of male workers aged 21 and over being 10d. per hr.

Durham.—From 14th May (when the present Order is due to expire) to 13th May, 1926. Continuation of existing rates except for an amendment by which the extra payment to horsemen of 21 years and over who are not householders and are not boarded and lodged by the employer is increased from 1s. 10½d. to 3s. 6d. per week.

N.B.—In the case of male workers aged 21 and over the minimum rates for the country are as follows:—

Horsemen: 32s. for 50 hrs. and any additional time spent in attention to horses, with an extra payment to such workers who are householders of 7s. per week, and to workers who are not householders and are not boarded and lodged by the employer of 3s. 6d. per week (as from 13th May).

Stockmen and Shepherds: (a) Householders 43s. per week; (b) workers who are not householders and are not boarded and lodged by the employer 37s. 10½d. per week; (c) workers who are boarded and lodged 36s.; the wages in each case to cover the hours customarily spent in attention to stock.

Other Adult Male Workers: 32s. per week of 50 hrs.

Hereford.—From 1st May (when the previous Order expires) to 30th April, 1926. The new Order fixes a special minimum rate for male workers aged 21 and over employed wholly or mainly as bailiffs, waggoners, stockmen or shepherds of 36s. per week for all time necessarily spent in the immediate care of animals (not exceeding 60 hours). The minimum rate for other classes of male workers aged 21 and over remains unchanged at 31s. per week of 48 hrs. in winter (November to February), and of 54 hrs. in summer (remainder of year), and no change is made in the rates for younger male workers or for female workers.

Kesteven and Lindsey.—From 27th April to 15th February, 1926. Minimum rates of wages for male workers under 21 years of age employed wholly or mainly as waggoners, the rates for workers aged 20 and under 21 being 30s. per week of 48 hrs. in winter and 52 hrs. in summer with an additional payment of 7s. per week to cover time spent in connection with the care of horses.

N.B.—Minimum rates on a similar basis are already in force for waggoners aged 21 and over.

Somerset.—From 27th April to 29th September, 1925. Overtime rates for male workers and minimum rates for female workers, the overtime rate for male workers aged 21 and over being 7½d. per hr. for the first hour of overtime employment on week days and 9d. per hr. for subsequent weekly overtime employment and all employment on Sundays. The minimum rate fixed for female workers aged 21 and over is 6d. per hr.

Wiltshire.—From 27th April to 11th October, 1925. Reduction of the minimum hourly rates of wages for female workers under 18 years of age to 4½d. for workers aged 17 to 18, 3½d. for workers aged 16 to 17; 3d. for workers aged 15 to 16; and 2½d. for workers aged 14 to 15 years.

Anglesey and Carnarvon.—Minimum and overtime rates of wages for male workers and minimum rates of wages for female workers from 14th May (when the present Order expires).

The new Order continues the present rates unchanged, the rates being in the case of male workers aged 21 years and over (a) horsemen, cowmen, shepherds or hwsmyn (bailiffs) 35s. per week of 58 hrs.; (b) other male workers 30s. per week of 50 hrs. and, in the case of female workers aged 18 and over, 6d. per hr.

Denbigh and Flint.—From 11th May to 15th February, 1926. Minimum and overtime rates of wages for female workers, the minimum rate in the case of such workers aged 18 and over being 5d. per hr., with overtime at 6¼d. per hr.

Glamorgan.—From 11th May, 1925, to 1st March, 1926. Special minimum rates of wages for male workers employed wholly or mainly as stockmen, cattlemen, cowmen, horsemen, shepherds or bailiffs, the rates being for workers aged 21 and over 40s. per week of 60 hrs. The minimum rates for other classes of male workers and for female workers remain unchanged, being in the case of male workers aged 21 and over 37s. 6d. per week of 53 hrs. in summer (1st March to 31st October) and 51 hrs. in winter (remainder of the year).

Merioneth and Montgomery.—From 2nd May (when the previous Order expires) to 1st May, 1926. The new Order increases the minimum rates of wages for male workers aged 21 and over by 6d. per week, the rates from the 2nd May being for stockmen, teamsters, carters or shepherds 34s. 6d. per week of 60 hrs. and for other adult male workers 31s. 6d. per week of 54 hrs. The minimum rates for male workers under 21 years of age and for female workers remain unchanged.

Radnor and Brecon.—From 3rd May (when the previous Order expires) to 14th February, 1926. The weekly rate for male workers aged 21 and over remains unchanged at 31s., but with variation in the number of hours in respect of which it is payable, the hours becoming 54 instead of 52 in summer (15th February to 14th October) and 48 instead of 50 in winter (rest of the year).

Copies of the Orders in full can be obtained on application to the Ministry.

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Goats in England and Wales.

THE Ministry has obtained from its Crop Reporters returns of the number of goats in each parish in England and Wales. These returns show that the number of goats in January, 1925, was practically 60,000. To some extent the returns were estimates, but as they were based on a considerable amount of local inquiry they may be taken as fairly reliable, and their accuracy is corroborated from another source. While the Crop Reporters were collecting information on which to frame their estimates the Ministry asked members of the British Goat Society to furnish returns of the number of goats which they owned, and to give estimates of the number in their parishes or in adjoining parishes with which they were well acquainted. Estimates in respect of 1,000 parishes were obtained in this way and agreed very closely with those furnished by the Crop Reporters for the same parishes.

On the whole more goats are kept in the east and south-east of England than in other parts of the country. The four

counties in which the largest numbers are kept are Essex, Norfolk, Hampshire and Durham, in each of which there were between 3,000 and 4,000 goats, Kent, Cambridge (including the Isle of Ely), Suffolk and the West Riding of Yorkshire had between 2,000 and 3,000, and the East Riding of Yorkshire, Surrey, Sussex, Berkshire, Buckingham, Gloucester, Wiltshire, Somerset, Dorset, Devon, Yorkshire, N.R., Lancashire, Cardigan and Carmarthen had between 1,000 and 2,000. As regards Wales, the great bulk of the goats kept are in the south, nearly 5,000 being returned for the six southern counties against rather less than 1,000 in the north.

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Importation of Plants into Canada.

THE Canadian Government have asked the Ministry to remind nurserymen and others concerned in this country that hay, straw or fodder must not be used as packing material for goods exported to Canada unless a certificate of sterilization, or an official certificate stating that the hay, straw or fodder came from an area free from foot-and-mouth disease, is attached to the container. The term "fodder" is interpreted in its widest sense and includes chaff, rice-hulls, buckwheat hulls and practically everything that might come into contact with live stock.

Exporters of plants, bulbs, etc., to Canada are accordingly advised to pack their consignments only in such materials as clean sphagnum moss, excelsior, wood-wool, shavings, sawdust, and similar materials.

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Swan Quills.

THE Ministry understands that swan quills, the importation of which into the United Kingdom is prohibited by certain of the provisions of the Importation of Plumage (Prohibition) Act, 1921, are required by makers of artists' brushes and fishing tackle in this country. The quills are shed naturally once a year, and it is desirable that these supplies should be made available for manufacturing purposes.

The Ministry would be glad to put any persons who have or may have supplies of such quills in touch with possible buyers. This can also be done in the case of goose, turkey and duck quills, the importation of which is not, however, prohibited. Letters should be addressed to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, S.W.1, quoting Reference No. T.B. 185.

The Care of New Woodlands.

LARGE areas of land throughout the country are being planted with trees by the Forestry Commission. This year between 15,000 and 16,000 acres have been planted and 30,000,000 young trees have been put into the ground amid suitable conditions for growth and development. Next year the programme extends to 18,000 fresh acres, and much of the land which is being dealt with in this way is situated in places frequented by tourists. It is hoped that everyone will realise that these new forest areas are public property and will help to protect and care for the young plantations and woods that they may grow into an asset of great importance to the nation. This is the intention with which these plantations are being made, for owing to the serious inroads made during the War into our supplies of growing timber, our woods were sadly depleted.

The greatest enemy is fire, and a carelessly dropped match or cigarette end may be the cause of widespread ruin and loss. Young plantations are extraordinarily inflammable, and fires, although so easy to start, are extremely difficult to check and extinguish. Where a fire is lighted in the vicinity of any woods or plantations it is earnestly requested that great care should be exercised to put out the embers completely before the place is left.

Broken glass is also a source of danger, for the pieces lie sometimes in a situation in which they focus the sun's rays and act as a burning glass. Many destructive forest fires have been commenced in this way, and this is only one of the reasons why glass bottles should never be left strewn about or broken up out of doors.

If all people will co-operate, the danger of forest fires is reduced enormously, and a little forethought is all that is necessary. The woods which will result from the efforts now being put forth will be a grand legacy to the future, and a source of endless delight to lovers of the countryside and profit to the nation as the trees develop and mature.

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Foot-and-Mouth Disease. There was no development of disease in the Wadsley Bridge outbreak and all restrictions in that district have been withdrawn. The second outbreak referred to in the May issue of the *Journal* was confirmed on premises at Great Houghton, Northampton, on 19th April. Disease was also confirmed on adjacent premises on 30th April, whilst other outbreaks occurred at Overstone, near Northampton, on 6th May, and at Rugby a day later, all the cases having an indirect connection. This has subsequently been reduced.

The usual restrictions have been imposed in connection with these outbreaks.

An outbreak of disease also occurred at Hampton, near Malpas, Cheshire, on 5th May, necessitating the application of restrictions to an area within 15 miles radius.

Since 1st January, 1925, 21 outbreaks have occurred in 9 counties, involving the slaughter of 784 cattle, 319 sheep, and 560 pigs, and the payment of £30,152 in compensation.

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NOTICES OF BOOKS.

Profitable Bush Fruit Culture.—(J. W. Morton, F.N.I.A.B., F.R.H.S. London: Ernest Benn, Limited. Price 2s. 6d.) This little book provides an account of the cultivation under commercial conditions of what are known as "bush fruits," *i.e.*, gooseberries, black, red and white currants, and raspberries. It is disappointing to find loganberries, an established commercial crop, omitted from a book of this nature.

A chapter is devoted to each crop and is divided into sections dealing with soils, varieties, pruning, manuring, propagation, pests and diseases, and marketing. Two chapters are given to such subjects as summer pruning, birds, tools and implements, while the final division of the book consists of a useful calendar of operations.

The sections dealing with cultural operations are representative of sound commercial practice. Those on manures are a little fragmentary in character. Some useful information is given in the sections dealing with varieties. In connection with raspberries no reference has been made to the widespread confusion of nomenclature, and that at least three, if not more, distinct varieties are distributed as Baumforth's Seedling, and similarly in regard to the Hornet variety.

The statement, on page 6, that "black currants belong to a separate family to red and white currants" seems to be a misleading method of stating that the black, red and white currants are distinct species of one genus. That gooseberries are usually grown on a single stem will come as a surprise to Kentish growers, who have long been in favour of the stool bush system. True it is that the leg bushes are the most suitable for the high-class dessert varieties, which require hard pruning in order to obtain quality, but most experienced growers will eschew this system where the main object is the production of green berries.

The sections devoted to descriptions of pests and diseases are particularly complete and some useful remedies are given.

In his opening chapter the author lays emphasis upon the importance of exercising care in the purchase of fresh stock when forming new plantations. He reiterates this when discussing the so-called "reversion" disease of black currants, and prospective growers of this crop will do well to take this advice to heart.

Written in simple, colloquial language, this little book forms a useful guide to the cultivation of these crops and constitutes a fit companion volume to the rest of this series of practical handbooks issued by the publishers.

Éléments de Pathologie Végétale Appliquée à l'Agronomie et à la Sylviculture.—(E. Marchal. Gembloux: Jules Ducolet; and Paris: Libraire Agricole de la Maison Rustique. 1925.) This volume is the second of a series published under the auspices of the Bibliothèque Agronomique Belge, and designed to extend a knowledge of the results of higher agricultural teaching and research in plant

and animal technology to those who are most directly concerned in the industry on its practical side. From this point of view, therefore, the book is to be looked upon as a more or less popular exposition of modern plant pathology. The author has for nearly thirty years held the position of State Phytopathologist in Belgium, and should, therefore, be well qualified to write with authority on the diseases of cultivated plants and trees, which commonly occur in that country. In addition he deals with some of the diseases of plants cultivated in the tropics (Belgian Congo), such as those of cocoa, rubber, sugar cane and cotton

The book, of just over 300 pages, is divided into three parts. Part I, which occupies about five-sixths of the whole, deals with diseases due to parasites of vegetable origin. In the first chapter the nature of parasitism itself is discussed and the legislative, cultural, prophylactic and therapeutic measures in general use are set forth. The second chapter, a long one of over 200 pages, contains detailed descriptions of the diseases caused by bacteria, slime-fungi, fungi, algæ and lichens, and includes a short account of the chief phanerogamic parasites, such as mistletoe, dodder, and so on. The diseases are arranged according to the parasites which cause them, and measures of control are suggested in each case. In chapter 3 some eight or nine pages are devoted to the subject of virus diseases, such as Leaf Roll and Mosaic in potato, Mosaic in tobacco and tomato, and the Sereh disease of sugar cane. So-called physiological diseases are treated of in Part II, where the effects of external factors, such as soil, heat, light, air, meteoric agencies, etc., on the health of the plant are rather briefly summarised. The third Part consists of an analytical table or key in which, under the various hosts, brief descriptions are given, by the aid of which the chief diseases can be diagnosed in a preliminary way, and reference then made to the fuller descriptions in the body of the work.

There are about 150 illustrations, some original but others taken from various sources in Europe and America, some of them being from the English Ministry's publications. Many of them are from half-tone blocks, but owing probably to the unsuitable character of the paper on which they are printed, the results often leave a good deal to be desired on the score of clarity.

The book is, of course, not intended for advanced students and no references to literature are provided.

It is interesting to find it stated that Wart Disease of the potato has not yet been found in Belgium, although from a German source it has been suggested that it was present near Ypres during the war. Onion Smut is rather rare and does little damage there, whilst the reported existence in Belgium of *Endothia parasitica*, the fungus which has almost exterminated the Sweet Chestnut in the eastern part of the United States, has not been confirmed.

Year Book and Annual Report of the Essex County Farmers' Union, 1925.—(Chelmsford, 2s. 6d. net.) This annual well maintains the high standard set by its edtior in previous years. In addition to all the information that an Essex farmer would expect to find in his year book, it contains a large number of excellent articles, which make up a volume that every farmer, in whatever part of the country he may live, would find one of the best half-crown's worth he could hope to acquire.

A very few of the articles can be mentioned here. The Hon. E. C. Strutt, in "The Future of Agriculture," by a brief survey of the trend

of wheat and live stock prices appears to point to a prospect of better things to come for British agriculture. " A Review of Agricultural Research," by Professor Wood, describes briefly the large amount of research which has been carried out since the war, with a few striking examples of results achieved. The manner in which research is really influencing the practical work of farmers is well suggested by this article. " Prehistoric Crops," by Professor Sir R. H. Biffen, contains an interesting account of grain—wheat, barley, oats and beans—dug up in prehistoric villages in the West Country that were inhabited 2,000 years ago, before the Roman occupation. Articles on " Agricultural Education in Essex " and " The Work of the Official Seed Testing Station " show the useful work for agriculturists now being done respectively by a progressive County Council and a National Institution. " Village Life," by the Countess of Warwick, and " The Enclosures and their Bearing on Modern Problems," by J. L. Hammond, discuss similar problems of country life from different points of view and reach most stimulating conclusions.

The last that can be mentioned here is an article on " Poultry-keeping for the General Farm," by C. A. Flatt, which mainly compares the advantages of egg production and the sale of pullets, both branches well adapted to the conditions of a general farm, but the former requiring considerable capital expenditure for the profitable branch of winter egg production and the latter needing little capital. A large number of other articles which cannot be mentioned here are equally suggestive and will repay study by all farmers.

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ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

Branson, E. C.—Farm Life Abroad: Field Letters from Germany, Denmark and France. (310 pp.) University of North Carolina Press; London: Oxford University Press, 1924, 9s. [63 (43) (489) (44).]

Dunlop, J.—Scotsmen Farming in England. (48 pp.) Kilmarnock: "Standard" Printing Works, 1925. 1s. 6d. [63(42).]

Farrow, E. P.—Plant Life on East Anglian Heaths: Observational and Experimental Studies of the Vegetation of Breckland. (118 pp. + xxiii pl.) Cambridge: University Press, 1925, 7s. 6d. [58.19(42).]

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NOTES FOR THE MONTH.

Register of Dairy Cattle.

VOLUME 8 of the Ministry's Register of Dairy Cattle will be published early in July and will contain particulars of cows recorded under the Ministry's Scheme during the year ended 1st October, 1924. It is hoped that the alterations that have been made in the conditions of entry and in the arrangements for issue will tend to increase the value and usefulness of the Register.

The principal modifications in regard to entry in and issue of the Register are that entries are not now confined to cows in respect of which certificates have been issued and applications for entry have been made by their owners, nor is any charge made for Volume 8 to members of Milk Recording Societies as has previously been the case. The Register will be issued free to them, and to many Agricultural and other Societies and Institutions interested in the Dairy Industry. The sale price of the Register is only 1/-, and it can be obtained from H.M. Stationery Office, at Adastral House, Kingsway, London, W.C.2, or through any Bookseller.

As a result of the imposition in 1921, on grounds of economy, of a charge of 5/- for a certificate, there has been a considerable decrease annually in the number of cows entered in the Register. There were only 1,821 entries in Volume 7, and these did not include many of the high-yielding cows because they had not been certificated.

Under the altered conditions of issue of Volume 8, particulars will be published of 5,000 of the cows recorded under the Ministry's Scheme which have the highest yields according to the standards prescribed for their breeds.

These standards are as follows:—

Friesian	10,000 lb.
Ayrshire, Blue Albion, ... Lincoln Red Shorthorn, ... Red Poll, Shorthorn and Crossbred	9,000 lb.
All other breeds or types ...	8,000 lb.

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Approximately 13,000 cows out of 138,000 recorded reached these standards, but considerations of space and cost of publication have prevented the inclusion of more than 5,000 of them in Volume 8. It is hoped, however, that it may be found possible to increase the number of entries in future Volumes of the Register if financial conditions permit.

Approximately 62 per cent. of the cows entered in the Register are Shorthorns. With the exception of Friesians, which account for 17 per cent., no other breed is represented by more than 3 per cent. Of the 4,764 members who recorded during the year ended 1st October, 1924, approximately 41 per cent. own cows which appear in the Register.

In addition to the entries of the cows mentioned the Register contains particulars of cows in respect of which Certificates of Merit have been issued, and of Pedigree Bulls whose dams and sires' dams have reached the prescribed yields for their breeds.

* * * * * *

Clean Milk Competitions.

IT is estimated that during the present year nearly 1,000 dairy farmers will take part in the clean milk competitions that are being organised by County Education Authorities under the guidance and with the financial assistance of the Ministry. Thus, quite a number of producers will be engaged in paying special attention to their methods of milk production, stimulated by the hope of a challenge cup, or a medal or a certificate.

The benefits of a clean milk competition are not limited to the gaining of awards. Their more permanent value is the educational work which the competition carries with it. Under the stimulus of the prospect of gaining a high place, producers lend a ready ear to the suggestions of dairy advisers and are brought face to face with the things that matter in clean milk production. Perhaps more important still, the milkers and other farm employees have their interest awakened, and acquire an enlightened outlook.

The competitions consist in the taking of fair samples of the farmer's milk at regular intervals, and the examination of these samples for bacterial content, keeping quality, fat and sediment; the equipment and condition of the cowhouse and milk-room are also taken into account, and surprise visits are made by the inspecting judges. The County Educational staff give advice throughout the competition, and periodical reports are issued to the competitors, giving counsel based on the results of examining samples up to date.

The day of the public meeting at which the cup and other awards are distributed, is the gala day for a good many farmers in the neighbourhood, and those who are not fortunate enough to receive a certificate have at any rate the satisfaction that they can try again next time, and that meanwhile, as all names in the competition are confidential, no publicity is given to any except the leading contestants.

The benefits of these competitions may be briefly considered. First, as to the public. The competitions form one of the best means of bringing about an improvement in the cleanliness of the milk supply. If milk is clean, it is safer, sweeter, and in every way more desirable. In this country much more milk ought to be consumed; the consumption is much greater in such countries as Denmark and the United States. One reason why consumption of milk remains low is that consumers are suspicious of its cleanliness. There is an ever-growing section of the community prepared to pay a slightly better price for a cleaner article. Sometimes, the publicity that comes from taking a leading place in a competition may in itself be sufficient to enable a producer to build up a retail trade amongst this class of consumer. More generally, he must first take out a Ministry of Health licence for the production of Grade A milk. Clean milk competitions have often been the means of showing farmers that they can produce milk of this standard solely by attention to details, and with little or no capital outlay on building or equipment.

The Ministry would like to see this movement extend over every milk-producing area in the country. In localities where no competition is contemplated and where dairy farmers wish to have one, they should get their Union or Society to approach the Local Education Authority and ask for one.

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Export of Live Stock for Breeding.

A STATEMENT is published in this issue of the *Journal*, p. 379, showing the number and value of cattle, sheep, and swine exported from Great Britain and Northern Ireland for breeding purposes, and the countries to which they were sent, during the three months ending 31st March, 1925.

The tables which appear in the Monthly Accounts relating to Trade and Navigation give the figures for animals consigned to a few countries, classing the remainder

under the heading "other countries." Since 1st April, 1923, however, the animals sent from Great Britain and Northern Ireland to the Irish Free State have been treated as exported and have been included in the figures for the "other countries." The result is that the ordinary commercial stock transactions which take place between this country and the Irish Free State are included with the export of high-class stock for breeding purposes.

The Ministry will, therefore, in future publish quarterly in this *Journal*, a table (compiled from figures supplied by the Customs and Excise Department) showing in as much detail as possible, the countries to which stock are exported, and the average declared value of the animals, giving separately the figures for those sent to the Irish Free State.

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Important Judgment with Reference to the Seeds Act, 1920.

AN important judgment with reference to the Seeds Act was delivered by Judge Farrant at Peterborough on 31st March, in a case in which a farmer was sued for the price of some maple peas, and in which he set up the defence that the plaintiff had failed to deliver a statement in writing containing the prescribed particulars as to variety, percentage of germination, purity, etc., as required under the Seeds Act, and that the contract for the sale and purchase of the seed was therefore illegal and unenforceable. Judge Farrant decided that this defence was a sound one, and delivered judgment for the defendant with costs.

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A Residential College for Land Workers.

A RESIDENTIAL college for land workers, which has been constituted on a somewhat novel basis, has recently been opened in Worcestershire. The establishment of the college, which is to be known as "Avoncroft," has been made possible through the generosity of Mr. George Cadbury, who has presented to the Trustees two houses, a bungalow and fourteen acres of fertile land at Offenham, on the River Avon, near Evesham.

The main purpose for which the school has been founded is that of providing education in the wider sense, and the curriculum is not limited to technical instruction of the type provided by the existing Farm Institutes established under the scheme of

the Ministry of Agriculture. The new college is closely allied with "Fircroft," a residential college for workers at Bourneville, Birmingham, founded in 1909. This college has succeeded in developing personality to a remarkable degree in the course of three or even two terms of study along broad humane lines. "Avoncroft" is primarily intended to extend the same opportunity to the rural worker.

The college course, which will consist of two terms of about eleven weeks each extending from October to March, with a short vacation at Christmas, seeks to give the student a broad, general outline of modern history, literature, economics, sociology and thought, with particular reference to rural conditions and rural applications. Practical instruction will also be given with the object of introducing the student to the most modern methods of small farming, together with the various sciences upon which they are grounded. A library of text books and reference books is being provided, so that the students may have the opportunity of becoming acquainted with books of the type which will be of use to them in their after life. Instruction will be given in carpentry and the care of agricultural machinery, and certain home industries, such as basket-making and hurdle-making, may also be taught.

Visits will be paid to research and demonstration stations, with the object of widening the interest of the students and bringing them into contact with those whose business it is to investigate agricultural problems and furnish advice. Ultimately it may be possible to arrange for tours to other parts of the British Isles and abroad for the study of special agricultural conditions. The social life of the students will also be provided for; a workshop and gymnasium have been constructed and provision is made for games.

The proposed curriculum includes English language and literature, history and economics with special reference to agriculture, agricultural sciences, farm accounts and costings, agricultural organisation, practical work in workshops and forge, and six hours a week farm practice and gardening.

Mr. F. M. H. Holman, M.A., has been appointed warden and will lecture on cultural subjects. He will be assisted by lecturers with practical experience.

Residential accommodation will be provided for from twelve to fifteen students (16 to 18 years of age) and the fee covering residence, board and tuition will be £20 for one term or £36 for two consecutive terms.

Several bursaries have already been offered towards the fees of students staying two terms, and these will be awarded by the Committee to suitable applicants in cases of special merit.

The Warden, Avoncroft, Offenham, near Evesham, will be glad to answer inquiries and to arrange for interviews with any who are specially interested in the scheme.

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The Wild Onion.

As the Wild Onion (*Allium vineale*, L.) is troublesome on a field at the University Farm, Cambridge, it has been decided to lay down some experiments in the hope of arriving at an economic method of eliminating this troublesome weed on heavy clay.

The importance of gaining the benefit of farmers' experience and observation before designing the experiment is fully recognised. Amongst the suggestions which have already been collected are the following points:—

(1) Drainage.
(2) Heavy manuring with dung.
(3) A succession of fallow crops.
(4) A succession of spring planted crops.
(5) Bare fallowing commencing by autumn ploughing.
(6) Tillage during frost.

If any reader of this note can suggest other methods which he believes to be successful in dealing with this weed, Mr. A. Amos, Director, University Farm, Huntingdon Road, Cambridge, will be glad to hear from him, with the object of incorporating suggestions in the experiments.

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British Delegation to the Warsaw Congress.

A SHORT programme of the International Congress at Warsaw in June, 1925, appeared in this *Journal*, May, 1925, p. 189. A delegation from this country attended the Congress, and consisted of Sir Daniel Hall, Chief Scientific Adviser to the Ministry of Agriculture, Mr. Dan Crawford and Mr. E. W. Langford (National Farmers' Union), Mr. Alfred Wood (British Sugar Beet Growers' Association), and Col. Meysey Thompson.

* * * * * *

AGRICULTURAL RESEARCH IN RELATION TO THE COMMUNITY.*

Sir Daniel Hall, K.C.B., LL.D., F.R.S.,
Chief Scientific Adviser to the Ministry of Agriculture and Fisheries.

It is a common reproach that agriculturists have not made the same use of science as have those engaged in the other great industries—that farming is still a rule-of-thumb process carried out by methods which have their origin in the dark backward and abyss of time. In some respects this is indeed true. One has only to read Cato or Columella to realise that the Italian peasant of to-day is working and living in very much the same way as his Roman forbears, and even the more highly organised farming of Great Britain or Denmark or Holland is carrying on many of the essential operations of cultivation on lines that were laid down by the first great civilisers—the Romans. It is easy in fact to trace modern agriculture to a Roman ancestry; in Britain, for example, by the transplantation from the fifteenth century onwards of the traditions and practices that persisted through the Dark Ages in the Low Countries.

None the less progress has taken place and scientific development is going on. Under mediæval systems of agriculture the yield from England's land was of the order of six to eight bushels of wheat to the acre. The enclosure of common lands, the introduction of a recuperative clover crop into the rotation and of forage crops like turnips for the winter feeding of cattle and the making of farmyard manure, the return to Roman methods, in fact, raised the level of production to about twenty bushels of wheat per acre. This was about the average when agricultural science dawned nearly a hundred years ago—say about 1840, when Liebig exposed his theory of plant nutrition and Lawes began his experiments at Rothamsted. Growing scientific knowledge and the introduction of fertilisers raised the level of English production by 50 per cent. during the next generation, so that by 1870 the average yield of wheat per acre in England had become thirty-two bushels. At that level it has more or less remained down to the present day because a new factor then came into play, the importation of cheap wheat through the opening up of the Middle West of the United States, and of Argentina and Australia. The economic factors

* An address delivered before the Graduate School of the U.S. Department of Agriculture, 26th January, 1925. Reproduced from *Science*, 17th April, 1925.

of gold scarcity and rising costs of labour co-operated to limit the profit attached to high farming: the English farmer had to cheapen his production and lower his standard so that he only obtains the same yield to-day, though the acreage under wheat has shrunk on to the better land. Latterly we have seen the yield creeping up a little through the introduction of heavier cropping wheats—the products of scientific research.

In other directions there has been progress. The introduction of the self-binder alone has meant great economies in man power. I estimate that by the use of machinery in one way or another English farming, with an equal or greater output, employs some 25 per cent. less labour than it did fifty years ago. Cattle feeding is more economic. Breeding for early maturity, better adjustment of rations either for meat or milk production, have all tended to a cheaper output. There is still an immense margin for improvement. From scientific experiments one may calculate with some degree of confidence how much meat and milk a given quantity of fodder of one kind or another ought to yield. Yet when in the dark days of the war we took stock of our resources of cattle food, because tonnage could no longer be spared for aught but human food, soldiers or munitions, it was estimated that in the five years before the war the farmers of the United Kingdom at large only realised one-third of the meat and milk that was theoretically possible from the fodder that had been then available.

Disease amongst animals is another field in which research has not been idle; enormous savings have been effected in the average efficiency of our flocks and herds. Yet last year Great Britain had to pay a bill of approximately $20,000,000 to stamp out foot-and-mouth disease, and this was compensation only for slaughtered animals and took no account of the losses the farmers endured by the break-up of their businesses.

Great are the achievements and still greater the possibilities of agricultural research, but we must recognise that there are limitations to the effect of science upon agriculture which do not hold for the other industries. In the first place, in agriculture we are dealing with a living organism and the amount of control that we have obtained over plant or animal, over that stubborn essence we call life, is far less than we can exercise over inanimate nature, over iron or cement, over even the ether or the atom. When we attack vital problems we find that we cannot speed up processes or enlarge the unit in the way we can deal with the dynamo or spinning frame. It

still takes the wheat plant six or nine months to develop, and cows bring forth their calves neither more quickly nor more numerously for us than they did for Abraham. We see no way of growing three or four crops a year under temperate climatic conditions. The organisms we are dealing with will go through their cycle and you cannot hurry them. When you start hustling you find you let in secondary troubles of all sorts.

These limitations lie in the nature of things, and though on looking back we can count up the immense advances that agriculture owes to the application of knowledge we must not hope for sudden developments or revolutionary changes such as have been seen in flying or wireless telegraphy. In fact, for the time being I am bound to say that agriculture is actually suffering from the rapid developments and scientific achievements that have distinguished other industries. I say this advisedly and most solemnly. Agriculture is the fundamental industry, because we must all be fed, and yet you cannot point to any part of the world where agricultural wealth is being turned out and find the producers in a flourishing condition.

The rewards in agriculture, whether to the capitalist entrepreneur or to the labouring man, are not commensurate with those obtainable in industry or commerce, and so men are being drawn away to the towns and capital is being diverted from the farms. The movement is one common to all civilised countries, its sources are social as well as economic. The lure of the town has been secular, but modern facilities of communication and transport have given it a range of action hitherto unknown; yet it cannot go on for ever, for the world must be fed. One must interpret the steady rise of food prices which has marked this century, a rise now being resumed after the excessive fluctuations caused by the war, as evidence that we are approaching a limitation to the development of the towns because there is not food enough to go round.

The old economists would see a simple solution to this impasse; prices of food have only to rise sufficiently and men will be attracted back to the land in order to secure the profits it promises—the balance will be restored. But, looking back historically, has this ever happened? I can find no example of an urban population migrating into the country. If the countryside does replenish itself in men it is by breeding and by finding space in the country for the country bred. The

great increase in the food supplies of the world the last half century has witnessed has been due to the new countries becoming accessible, whereby opportunities were given to the rural population to put their sons on new land. But that process is nearly at an end, there are no longer the great vacant areas waiting for men.

Are we not to look for progress in another direction; can we not so intensify the farming of our existing land by taking advantage of science, machinery and organisation that agricultural production will become an industry capable of competing against other industries for men and capital? It was by a process of this sort, by enclosing the common lands and building up small capitalist businesses, that Britain succeeded a century and a half ago in meeting the needs of a population which was then beginning to expand as the industrial age approached. Our businesses have remained small, too small to be efficient to-day perhaps, and I can point to few examples of large scale industrial farming in successful operation.

In fact, though I pin my faith to big business on the land as necessary to the future production of food in order to meet the growth of cities, I am bound to say that the current seems sweeping in the other direction. Agricultural businesses, such as we have, find it difficult to pay the wages that will retain men on the land, with all its disadvantages of quietness and lack of amusement. Social and economic motives in our country are working towards the break-up of farming businesses into single-man or rather family farms, and similar forces have been even more powerfully at work in Continental countries in dividing up the land. The desire of men for independence, the determination to call no man master, the innate feeling among country folk that a man has a right to a bit of land of his own as he has a right to vote or to a soul of his own, makes in many countries the single-man holding a burning political question. And the man is ready to pay—to pay in labour, in days that endure from dawn to dark, in days that include the hours of his wife and children, in toil as against the regular pace of a factory, for the privilege of being a landowner.

But I doubt whether the process is fundamentally economic. Farming may become immediately more intensive when a great estate is cut up into small holdings, but the community so created becomes an unprogressive one, little fitted to take advantage of modern science, modern machinery, modern organisation. It is fundamentally uneconomic because it is

employing more men than are necessary to produce the food on which the community can be supported. I conceive it to be possible for 15 per cent. of the working population to be able to produce the necessary food for the rest of the nation, and the larger the margin that remains after this prime task has been performed of men who can be making boots and clothes, houses and motor cars, the greater the divisible wealth of the community.

But the only hope I can see at present for large-scale production, for organized industry on the land, lies in the advances that science can make. It is research alone that will enable the big agricultural business to compete with the excessive labour of the one-man farm, to pay wages and give conditions of life to its workmen equal to those prevailing in the urban industries. It becomes then a matter of the first import to the growth of civilization itself, not merely to agriculture, that agricultural research should be encouraged.

We may consider research from two points of view. In the first place, it is an intellectual affair carried out by the individual in response to the insatiable curiosity of the mind about its surroundings and its own existence. As such, it proceeds from an artistic impulse, it is not under control and it is not amenable to considerations of utility. Just as some men must write poems or paint or make music, as other men find themselves compelled to speculate, to become philosophers or metaphysicians, so similarly the class of men we are considering must investigate nature. The passion to do this is part of the man's make-up and cannot be created by any act of will on his part. I may remind you of the story of the old school-fellow who met Dr. Johnson at the height of his fame. "Doctor," he said, "I have often tried to become a philosopher myself, but cheerfulness will keep breaking in." And as a man cannot deny himself a desire to investigate, so he is not drawn to investigation by any ulterior motive.

I may take an illustration in the science of astronomy. Historically the study of the stars would appear to have had its beginnings in the search for useful knowledge. In the early civilisation of Egypt it was necessary to find out a means of determining exactly the length of the year and the recurrence of the seasons. Later on the delusive promises of astrology led to further observation, and as we know, the first organised observatories were built for the service of the sailor for the drawing up of what we call a nautical almanac. But these prime necessi-

ties were easily satisfied and the real science of astronomy cannot for the last hundred years have served any useful purpose to any man. None the less, the development of the science and the foundation of observatories has proceeded at a greater pace than ever before, purely in response to the universal feeling of curiosity. Oddly enough, this kind of knowledge has proved itself singularly attractive to the American millionaire, who has latterly been the great founder of observatories. Indeed the uselessness of astronomy is to many people one of its great attractions. A great astronomer once said to me, " One advantage I enjoy is that my science cannot make money for anybody. At least no merchant traffics in my heart." We may parallel this feeling with the remark of some noble lord who was being congratulated on his elevation to the Garter, " The best of the Garter is that it implies no damned nonsense about merit."

Research again possesses this quality in common with what are usually called the arts—its characteristic mental process is intuition. When we were students we used to be told that the two processes of thought by which science proceeded were deduction and induction. It was pointed out that the barrenness of the mediæval schoolmen was due to the fact that they worked by deduction alone from imperfect premises. Bacon became the father of modern science by recalling it to induction and to the painful collection of facts. Bacon's apothegm was recalled, " Hypotheses non fingo," and it was suggested that the method of science was to collect an assemblage of facts and put them into some kind of sorting machine, whereupon a theory will emerge. However, a little examination of the actual history of discovery soon shows that it does not proceed in such a fashion. The function of facts is to provide tests for your hypotheses, but you cannot begin to collect the facts unless you have a preliminary hypothesis.

Let me take an example in the science of meteorology. For generations people made observations of the weather, set down the records of temperature, rainfall, barometric height and so forth. Nothing whatever came of these facts until in the study one or two workers evolved from their own consciousness the theory of the cyclone. Induction in fact failed. Bacon's other great catchword, " Experimentum crucis," showed that he really had a better appreciation of the true processes of science, and the really beneficial influence he exerted upon the early science of the seventeenth century was that he directed men's attention to

experiment and to the mechanic arts as the sources of knowledge. To come back to our text, neither induction nor deduction complete the story of the mental processes by which investigation proceeds. We now realize a third category in the shape of intuition, the power of seizing the truth by a sudden flash of illumination. Indeed, the great discoverer may be a man in whom what is commonly called the scientific habit of mind is imperfectly developed. He may not be severely logical, methodical in his arrangement of facts, meticulous in accepting deductions.

As a recent example we may instance the late Sir William Crookes, whose marvellous discoveries certainly did not proceed by a process of minute but steady accretions from known foundations. By a sudden jump of mind he invented the radiometer, regarding which his explanations were mistaken, but his intuition led him from this point on to the whole gamut of high vacuum discovery which has resulted in such developments as the Röntgen rays, the elucidation of the structure of the atom, wireless telephony, etc. Sir William Ramsay provides another instance. In the eighteenth century Cavendish had noted that after removing all the oxygen and nitrogen from air a small residuum was left uncombined. In true scientific spirit he puts this down to the inevitable errors of the experiment. But working on the same track and worrying over the discrepancy between the atomic weights of nitrogen from different sources, Ramsay's intuition led him on to the discovery of argon and the range of new light elements.

So far I have only been considering research from its intellectual side as a response to man's curiosity, but the nineteenth century proved it had also a practical side inasmuch as it led to an enormously increased control over the forces of nature. I need not sing the praises of what has been effected by steam, by electricity, by modern medicine: willy nilly the results are being incorporated into our daily life. Research leads to efficiency, and efficiency is a means of making money. The modern State must cultivate research if it is to become efficient and survive in the world's competition; hence all are agreed now on the endowment of research, and since in farming there are no great business corporations, agricultural research must for many years to come be maintained by the State.

If, then, research is to become of such importance to the State, it behoves us to ensure conditions for the research worker under which discoveries are likely to be produced. To do this

properly we must understand the psychology of the investigator. If it is true that research, like art, grows by a process of intuition, we can no more organize it into existence than we can organize the output of poetry. Nor are we likely to obtain it by a system of prizes, of rewards, commensurate to those obtained in the great professions, in industry or commerce. What we can do is to contrive sheltered places in our community in which research workers can live. We cannot guarantee results, but we may wait in faith because, as we have said, the impulse to make discoveries is fundamental in man's mind. Now the sheltered places in which the research worker can live are the universities.

One last word, the State must have research in order to obtain efficiency, but does mankind really care about efficiency? At bottom man does not, he wants to "loaf and possess his soul." Efficiency is a beautiful word, but efficiency to what end? If pursued for its own sake it may become a curse. Many people have vivid recollections of the sufferings they endured under a really efficient parent in an efficient household. I, myself, am officially engaged in promoting efficiency, in bringing up the efficient farmer and in insuring the efficient use of the land. But I cannot help having a great deal of sympathy with the old-fashioned farmer, who is content with what the land brings him, who is making his living but not worrying overmuch about making money. He is often inefficient, but again he is often a very worthy human being.

To take another illustration, I have a vivid recollection years ago of a little piece of swampy meadow, half encircled by a brook, which after other wanderings found its way into the Thames. There was a patch of reeds and willows, an old salley garden, where the reed warbler swung her nest and flitted through the tangled herbage. The wet meadow itself was starred over in August with Grass of Parnassus. It was indeed one of the most southern holds of that flower of the cool northern hillsides. Well, the efficient man came along, saw his opportunity, grubbed up the willows and laid out the meadow in watercress beds. He is a benefactor of his kind and has caused millions of blades of an edible kind to grow where there was none before; but I have a sore spot in my heart for the vanished warblers and the lost Grass of Parnassus. I fear, however, that the pursuit of efficiency is one of those contradictory elements in man's make-up that won't let him rest, that is always urging him against his will towards further attainment. What a dreary prospect if it only results in adding an ever greater and greater popula-

tion to a world always working harder and harder! Is there any way out of this impasse? I can only again suggest the kindly force of that other element in the texture of men's minds, the passion for artistic expression. The winds of beauty come and go, but as they rustle through the tree of life, among the dropping leaves that are ourselves, men will cease from their toil to listen and pause to retell in song or story, in paint or stone, the message they bring.

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MOLE DRAINING BY DIRECT HAULAGE.

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No season has shown so clearly as the last winter, with its continuous heavy rainfall, how many acres of land needs attention to be given to field drainage. Whatever may be our view of the best method to employ, it is quite certain that for all practical purposes we must rule out tile-draining (or pipe-draining) as being impossibly expensive, since the cost to-day would in many cases amount to nearly as much as the land is worth. There are various other methods which it is possible to employ, but they entail trenching, and, even if the cost of tiles is saved, as may be the case with bush-draining, the expense of the trench alone is, broadly speaking, prohibitive. The one remaining method which is available to the heavy-land farmer is mole draining.

It should be stated at the outset that it is useless contemplating the employment of this method unless there is a clay subsoil, but since most of the land needing under-draining is land with a clay soil, there are few cases where this method is not effective. In other cases the trouble may be traced to defective outfalls, or a pan : and in either case the remedy must be sought in other directions.

Mole draining is by no means a new idea. The new factor which has created fresh interest in the system is the introduction of the tractor-drawn machine. Mole draining has been, for many years, performed by horses, and by steam-cable sets. There may still be seen at work examples of the old capstan horse gear, and though the process is excessively slow, the results are excellent. There are still lying about on farms other old ploughs intended to be drawn direct by 8 or 10 horses, but this system is both expensive and unsatisfactory, since it is very difficult to get a team of more than 3 or 4 horses to pull in unison.

The steam-cable system has been employed for many years and has drained a great many acres with excellent results, but it is not always available, as, for example, in some parts of the west of England, while, however excellent the work performed, it costs more than most farmers care to pay. This is almost inevitable, since two engines and four or five men are considered necessary.

The cost of mole draining depends upon three factors: the diameter of the mole, the depth of the mole and (when reckoned by the acre) the distance between each drain. The draught of the plough obviously increases with the size of the drain—a $2\frac{1}{2}$ in. mole requires much less power than a $3\frac{1}{2}$ in. mole, probably about half. Similarly, every inch in depth greatly increases the resistance, and consequently the power required. As the distance between each drain is increased so the cost of draining a field is reduced, and it is the practice of farmers when employing steam tackle not to require the drains to be close together. In this way the cost per acre may be kept at a comparatively low figure, but the draining may be relatively inefficient.

If we had sufficient knowledge of the laws governing the percolation of water through the soil and subsoil, we could probably work out fairly exactly a formula which would show how to produce a given effect (in this case, drawing off the surface water) by varying the diameter, depth and width of the moles. We have not this precise knowledge, but we know, as the result of trial, that a number of small moles comparatively shallow but close together will drain a field more effectively than a smaller number of larger and deeper moles. Incidentally it may be mentioned that, apart from draining the land, the disturbance of turf in the process of drawing moles undoubtedly improves grassland; and when mole drains are close together the turf of the whole field is effectively dealt with.

At this point we must introduce another factor which has a bearing on the relative efficiency of the system. Many of the older moles with a bore of 3 to $3\frac{1}{2}$ in. diameter have lasted for 30 or 40 years. When spread over so long a time the actual cost is very much reduced: and it might well be argued that, if moles of large bore at a considerable depth have lasted so long, we should be very cautious in adopting a newer system, however cheap it may be. It is, of course, true that if mole drains are made too shallow the soil in which they are drawn may not be solid clay, and hence the moles will not stand, or,

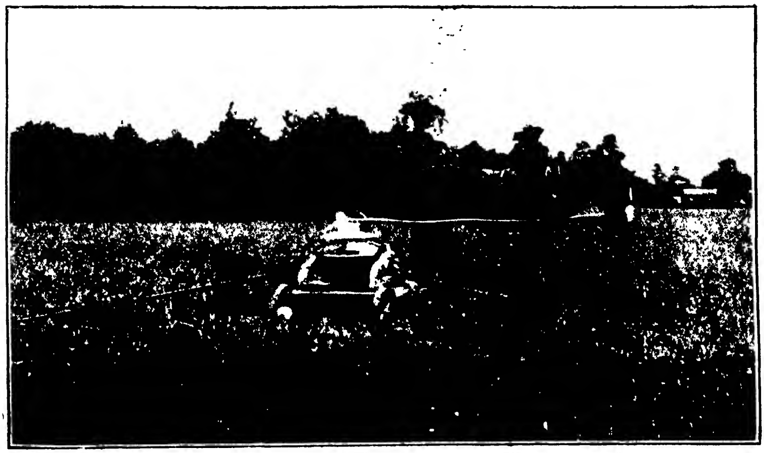

FIG. 1.—Capstan Horse Gear.

FIG. 2.—Capstan Horse Gear. View of Mole.

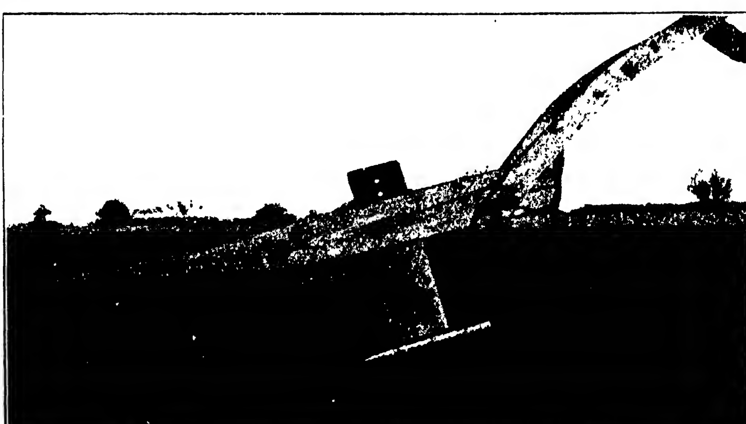

FIG. 3.—Direct Horse-drawn Mole-plough.

Fig. 4.—Mole draining with Steam Tackle: Fowler's Self-lifting Mole Plough.

FIG. 5.—Wells Mole-plough: in action.

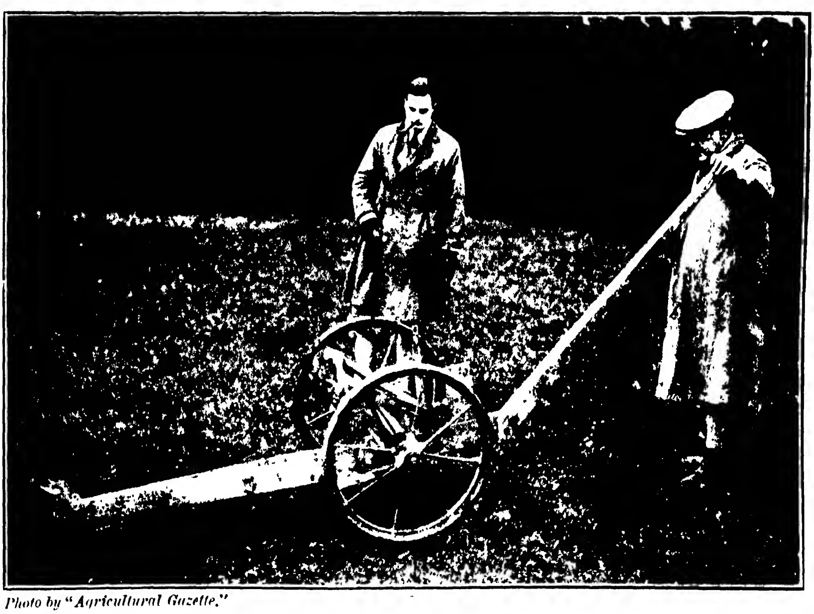

Photo by "Agricultural Gazette."

FIG. 6.—Wells Mole-plough (lighter type): cartridge entering ground.

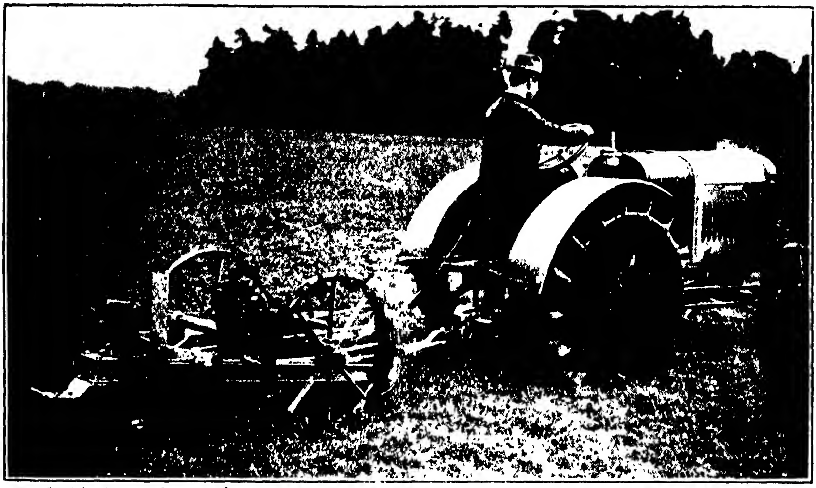

Photo by "Agricultural Gazette."

FIG. 7.—Martin Mole-plough : entering ground.

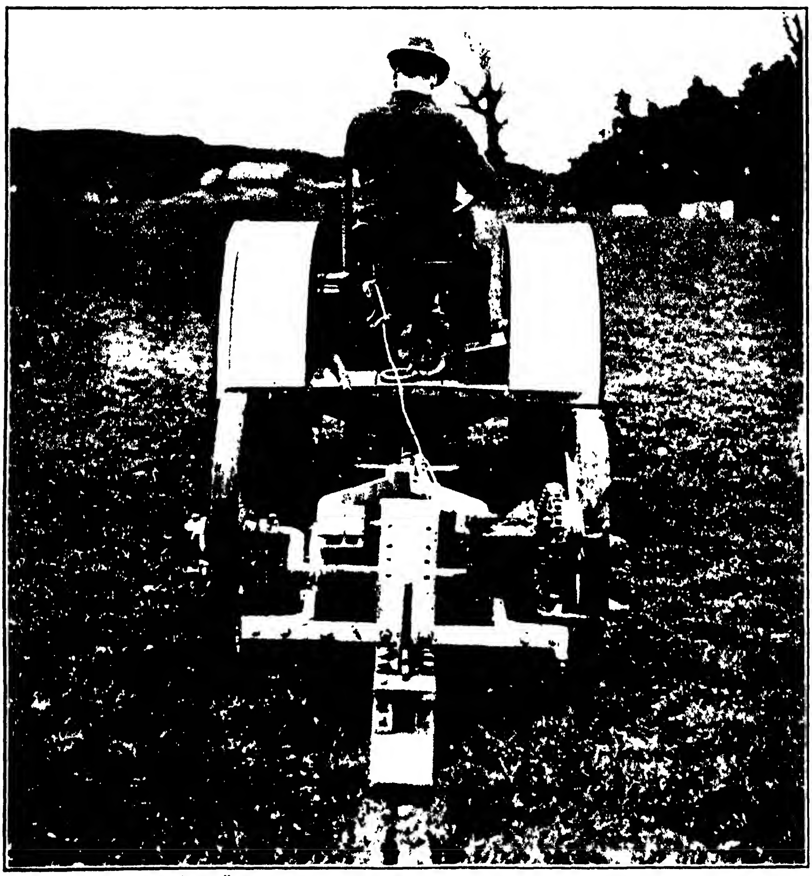

Photo by "Agricultural Gazette."

FIG. 8.—Martin Mole-plough : rear view.

even if it is clay, pressure from above may crush them. By practical experience, however, it has been found that moles made at 16 in. or 18 in. depth are perfectly formed and from their appearance show every sign of lasting.

Tractor Mole Ploughs.—The first effective tractor mole plough was introduced by Messrs. F. B. Wells and Sons of Welwyn. The head of the firm had had a lifetime's experience of steam-cable work, and the tractor-mole plough was designed to meet the normal conditions of farming practice. The implement consists of a main frame to which the coulter and a cartridge with a 2½ in. bore are attached: two floating wheels carry the beam when thrown out of operation: when at work the beam rests on two skids fixed at either end. A disc coulter cuts the turf in advance of the main coulter. A hand-lever enables the cartridge to enter the ground automatically at an angle and to be pulled horizontal as the tractor proceeds: this obviates the necessity for digging entrance holes for the cartridge as with the earlier types of horse and steam-mole ploughs; when the end of the drain is reached a spring catch is released and the cartridge automatically rises to the surface. The implement is made in several sizes and the lightest machine has a 2 in. bore.

Machines of similar type have been introduced by other firms, notably by Messrs. Martin and Sons of Stamford. The implement made by this firm is rather more elaborate and is fitted with a self-lifting device, which enables it to be operated by the tractor-driver. To enable this machine to be operated by the lighter type of tractor such as the Austin or Fordson, a furrow is first drawn: a sliding plate, attached to the rear of machine, is let down to the bottom of the furrow and the mole is drawn at, say, a foot below the plough sole but 18 in. below the surface of the field.

The type of tractor required depends upon the draught of the mole-plough, which as already stated varies with the size of the cartridge and the depth of the drain. It is useless to have a tractor which by reason of its small power cannot cope with the task. It is equally important that the travelling wheels shall be fitted with strakes or, preferably, spuds, which will grip the ground without digging in. If a tractor of sufficient power is provided and attention is given to the adhesion of the wheels, the work can be done speedily, efficiently and cheaply. About 800 chains of drain can be made in a day of 10 hours, using not more than 10 gallons of fuel.

Connection with Main Drains.—In laying out the drains each field must be considered individually: regard must be had to its fall, to the position of the outfalls, and to the existence of ridge-and-furrow. The cheapest method where the field is level and falls into an open ditch, is to back the mole-plough into the ditch and work up to the top of the field: the only additional cost is involved in inserting a 2 in. pipe at the end of each mole on the ditch bank to prevent closing up by the treading of cattle. Where the ground is not level or there is no open ditch main drains or grips must be cut on the lines corresponding as closely as possible to the natural drainage of the field and the moles led into them either herring-bone fashion or in parallel. The main drains should be cut after the moles have been made, otherwise the tractor passing over causes the walls of the trench to cave in.

The main drains should, if possible, be piped: if this cannot be done, on the score of expense, brushwood or clinker may be used with good results, which will continue for many years. Even where pipes are used, a layer of clinker or brushwood should be placed on top. If this is done and the main drain kept free, moles can, if necessary, be re-drawn at an interval of years without disturbing the main drain. The cost of making main drains depends upon so many factors that no precise figures can be given: it is, however, a comparatively simple matter for a farmer to work out the probable cost in any given circumstances.

A number of mechanical devices are available for cutting main drains. The Revolt Excavator is the cheapest, and in expert hands under suitable soil conditions will make an excellent job. A detailed description of this, and of other excavating machines, has already appeared in this *Journal* (February, 1920).

Mole draining should be performed between the months of October and May, since the wetter the ground the easier the work: but it must be remembered that when water stands upon the ground, wheel adhesion is likely to be seriously affected.

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Photo by "Agricultural Gazette."

FIG. 9.—Revolt Excavator: first cut.

THE REVIVAL OF FLAX GROWING IN ENGLAND.

FLAX is one of the oldest cultivated crops in the country. In the middle ages there were very few districts in which flax was not grown, and subsequently manufactured into linen to meet local requirements. Flax continued to be so grown until the eighteenth century, and although the home manufacture of linen gradually decayed, largely because of the introduction of cheap calico, the crop was still widely, though not extensively, cultivated throughout the first half of the nineteenth century. Then the cutting off of the greater part of the supplies of raw cotton as a result of the American Civil War stimulated the production of flax. The fibre, of course, was no longer required for home consumption, but to meet the factory demand. The area under flax gradually increased in Great Britain until it reached a total of about 24,000 acres in 1870. In that year 7,000 acres were grown in Yorkshire, nearly 3,000 in each of the counties of Lincoln and Suffolk, 1,800 in Norfolk, 1,200 acres in Cambridge. 1,100 acres in Somerset and 830 in Dorset. In Scotland 600 acres were grown in the two counties of Fife and Stirling and 400 acres in Ayr and Lanark. A large proportion of this area was grown for linseed, but not less than half was probably grown for fibre. After 1870 the decline in the cultivation of flax was rapid. In 1871 it had fallen to a little over 17,000 acres, in 1881 to 6,500 acres, in 1891 to less than 2,000 acres, in 1901 600 acres, and in 1911 it was less than 500 acres.

Assistance of the Development Commission.—In 1911 Dr. J. V. Eyre was appointed by the Development Commissioners to report upon the possibility, both from the scientific and practical point of view, of reviving the flax and hemp industries in Great Britain. Dr. Eyre examined the methods followed in all the chief flax-producing countries of Europe, and in his report he came to the conclusion that no difficulty was to be apprehended in raising good crops of flax in Great Britain, but that the management of the fibre processes, especially those of retting and scutching, could not be worked well into the routine of farm operations. It was recommended, therefore, that the possibility of centralising the processes of fibre separation, while leaving to the farmer the task of growing the crop, should be put to the practical test, and that two experimental factories should be established in suitable districts.

It is, of course, obvious from the figures mentioned that, unless the farmer has the stimulus of very high prices, he will not undertake the cultivation of a difficult crop which involves the manufacture of fibre. The point to be determined, therefore, was whether, when the obligation to manufacture the fibre was removed, the farmer would take kindly to this crop, which, from a broad standpoint, seemed a valuable one to the agriculturist and one that should lead to the establishment of rural industries and give rise to considerable local employment.

Experimental Work.—Dr. Eyre's recommendations were favoured with the approval of the Development Commissioners, and early in 1913 the British Flax and Hemp Growers' Society was formed under the Industrial and Provident Societies Act, 1893, to carry out the proposals that had been made. The University of Leeds provided technical assistance for the work in Yorkshire. In the same year experimental stations were established at Yeovil and at Selby and continued to be operated until the winter of 1917-18. During that period the acreage of flax grown and handled under the scheme increased from about 100 to 500 acres. The work of these five years showed definitely that a better strain of flax than that commercially available was required, since a crop yielding a better return to the farmer and a better fibre to the user would provide a much needed stimulus to the industry. A further point which emerged was that greater knowledge of the retting process was highly desirable in order that it could be efficiently controlled. Work was done upon both problems, as well as on that of the manurial dressings of the crop. The most important result was the production of strains of improved seed which held out promise of heavier and better crops in the future.

Flax Growing during the War Period.—The necessities of war cut right across this development work. The cessation of supplies from Europe gave rise to a demand for 10,000 acres of flax to be sown in England, primarily to provide seed for sowing in Ireland, but also to provide additional fibre for the manufacture of aeroplane cloth. The small experimental scheme was wound up, and the flax-growing industry entered on a period of war-time expansion and post-war collapse. The story is generally familiar. At the time of the Armistice in November. 1918, a Flax Production Branch of the Ministry of Agriculture, set up to organise flax growing, owned or had contracts for straw representing close upon £500,000. In view of the high prices ruling for flax products it seemed likely that the industry might

establish itself on the comparatively large scale to which it had then grown and that it should be possible to dispose of the factories as going concerns. But when in 1920 the various Government factories were passing or had passed into private ownership a heavy slump in the linen trade made it impossible to conduct them at a profit. As a result only two factories are now operating, one in Yorkshire and one at Bunford, near Yeovil. Meanwhile, the production of flax had increased to 18,000 acres in 1918 and 1919, and 22,000 acres in 1920. Nearly 6,000 acres were still under flax in 1924, but the greater part was being grown for seed and not for the fibre.

Imports and Home Supplies.—This country is very nearly concerned with the production of flax. In the ten years before the war the total imports into the United Kingdom of flax varied from 62,000 to 87,000 tons a year. The imports of tow varied from 15,000 to 20,000 tons. In 1922 31,000 tons of flax and 8,500 tons of tow were imported. Home supplies of flax are derived almost wholly from Ireland. Before the war they amounted to 10,000 tons and upwards to 15,000 tons of flax and tow annually. In 1921 the Irish production fell to about 4,300 tons, but by 1923 it had again increased to about 8,500 tons. At the present time foreign supplies are extremely uncertain, and the textile machinery in this country is half idle. At the same time it is quite possible to grow excellent crops in this country as well as in some parts of the Empire overseas.

A New Strain of Flax.—A further important consideration is that a new strain of flax of much promise has been evolved. The need for conserving and bulking the seed of this new strain, which is known as J.W.S., led to arrangements being made between the Linen Industry Research Association, the Imperial Government and the Government of Northern Ireland, by which the factories at Bunford and Lopen in the Yeovil district were taken over by the Association last year for the specific purpose of bulking the seed. Since then a strong Committee of the Board of Trade, under the Chairmanship of Sir Frank Warner, has been considering what steps can be taken to bring about the growing of flax seed and flax in the United Kingdom on a commercial scale.

In an Interim Report* dealing with the matters of most urgent importance, the Committee has reported that the growth of flax seed and flax on a commercial scale is dependent upon the development of new strains of pedigree seed. The position

* Board of Trade: Committee on Flax Seed and Flax Growing in the United Kingdom. Interim Report: Flax Seed. 1925, Price 6d. net.

is complicated by the fact that the Irish flax grower has not made a practice of saving seed from his crop. The climate of Ireland is not favourable to the ripening of seed, and the method of treatment there adopted has called for the pulling of the flax before the seed is ripe, and immediate retting without the recovery of such seed as has been produced. Consequently the Irish grower has been dependent upon seed imported from Holland and other continental sources.

On the other hand, seed can be grown and recovered in Somerset (as in other parts of Great Britain), and it is here that factory facilities are available which would enable the farmers to grow flax, while at the same time providing for retting to be centralised.

The Committee in effect recommends a return to the policy pursued before and in the early years of the war. In view of the prejudice created by the failure of the companies which took over the Government factories from the Flax Production Branch, there is no prospect of this work being undertaken in the ordinary way of business, and the Committee therefore recommends special Government assistance. It proposes that the two factories at Bunford and Lopen should be taken over by an appropriate body and contracts made with farmers for the production of seed and fibre. In the view of the Committee it should be possible for these factories to be working at their full capacity in 1926; after which seed should be available for sale in Northern Ireland, Scotland, the Dominions and Colonies. The seed, after being placed on the market, would be multiplied further by private enterprise; but the Committee thinks it essential that the factories should be retained permanently as a source of supply of mother seed, thus maintaining a continual supply of pedigree seed for distribution.

The Government have adopted generally the recommendations of the Committee, and without binding themselves to continuing in the business for more than a brief period of years, have arranged for the acquisition of the two factories and for the constitution of a Society, not trading for profit, under the Industrial and Provident Societies Act, 1893. Contracts for growing flax have already been made with farmers; there has been no break with the activities of the Linen Industry Research Association; and the work is developing in the way forecast by the Committee.

It is too early yet to say what success will attend the efforts of the Flax Industry Development Society. It is composed

principally of business men who are anxious and determined to make a commercial success of the venture. The Government, for its part, expects to recover the money invested and, when the time is ripe, to place the business on an ordinary commercial basis. Should anticipations be realised, we should see established in England a seed-growing business supplying flax seed of a quality never hitherto put on the market, and a great extension of the area of flax grown for fibre in all parts of the British Isles and in other parts of the Empire. At the same time the British linen industry would have an assured supply of superior fibre which should place it on a permanent basis of prosperity.

In this enterprise there are associated the Imperial Government and the Government of Northern Ireland, manufacturers and growers. The Linen Industry Research Association is intimately concerned with what is essentially a development of its own work, and the new Society will work in close relation with the older body. The work of the Society should not, therefore, fail for lack of technical guidance.

What it is essential to understand is, that the scheme is primarily one for supplying seed of superior quality and thereby providing the basis for the development of an existing industry. It is not a project for large scale manufacturing and trading. Obviously the success of the scheme depends upon the continued demand for fibre of high quality—of which there should be no doubt—and to no less a degree upon the willingness of the farmer to grow flax. This he undoubtedly will do if the price is right, and if a solution is found for the problem of relieving him of the fibre processes. The present scheme aims at ensuring a fibre of high quality and, therefore, of ready demand at a good price, and it provides facilities for retting and scutching flax locally grown. A system such as this holds out the best promise for reviving flax-growing in this country.

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AGRICULTURAL COSTINGS IN SWITZERLAND AND DENMARK.

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I.—SWITZERLAND.

IN 1924, the writer was granted a Travelling Research Fellowship by the Ministry of Agriculture and Fisheries for the purpose of studying agricultural co-operation and costings in Switzerland and Denmark. In this article, a summary is given of some of his impressions of the costing work in Switzerland. Denmark will be dealt with in Part II.

While in the work of Dr. Laur and his capable assistants at Brugg there is much to admire and much to imitate, one could not help feeling that in some respects at all events they might learn from us. In England, in Yorkshire at all events, the system of agricultural costings adopted has been built up on *service to the individual farmer concerned*, and the results obtained from a careful study of the accounts have been utilised largely as an aid to farm management. If English workers have erred in emphasising, possibly too strongly, the practical and utilitarian side of farm accounts, there is no doubt that in Switzerland and, to a less extent in Denmark, workers have erred in the other direction, and their point of view has been political and social rather than individualistic.

Realising that if a national agricultural policy were to be obtained in Switzerland, it was no use going to the Government or to the country with generalities, Dr. Ernest Laur, the well-known economist and secretary of the Union Paysans Suisses, has been engaged since 1901 in patiently, laboriously and systematically collecting and arranging statistical data taken from the carefully kept books of some four hundred farmers, whose accounts have been supervised through the Union.

The value of these trustworthy data has been inestimable, not only to the agricultural industry, but to the country as a whole, for on its evidence, and the lessons to be derived from it, a national agricultural policy has been built up, which has kept the land under the plough, made the growing of wheat still a paying proposition, safeguarded the agricultural industry, and made it possible for the producer of milk to obtain from 70 to 75 per cent. of the price paid by the consuming public.

The accounts of the farms supervised by Dr. Laur are kept on the "extensive" rather than the "intensive" system. The

book-keeping system adopted is made as simple as possible, but sufficiently accurate to provide reliable figures; no attempt is made to estimate the cost of production of each branch of the farm work, as this might necessitate too complicated a system of accountancy for the farmer who does his own book-keeping. Receipts and payments are entered in a detailed cash book, and records are made of all payments in kind made by the farm to the household, or of any such payments made by the farm to the staff. A detailed valuation is made at the beginning and end of the year. From the study of the records so obtained, a large amount of valuable information can be extracted, particularly if, with the object of framing a national agricultural policy, it is imperative to know exactly how the industry as a whole is standing.

Thus, the yearly variations in the labour bill, the total working expenses and gross and net returns when expressed on the basis of unit of area, and particularly the net returns when expressed as a percentage of capital invested, as determined by Dr. Laur form very interesting reading.

TABLE I.

Swiss Results on 6,057 Holdings.

Year	Labour Bill per acre			Gross Output per acre			Working Expenses per acre			Net Returns per acre			Net Returns as per cent. of capital invested	Total Capital per acre		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	per cent.	£	s.	d.
5 years 1901-5	4	12	5	9	18	6	7	8	3	2	10	4	3.13	80	8	6
7 ,, 1906-13	6	1	6	13	19	11	10	6	0	3	12	9	3.67	99	3	6
1914 - -	5	9	4	13	4	7	9	16	9	3	7	10	3.75	96	15	9
4 years 1915-18	7	7	6	22	4	6	12	7	5	9	17	1	9.84	100	2	2
1919 - -	11	13	2	28	12	0	19	15	6	8	16	6	7.94	111	0	0
1920 - -	12	9	0	27	17	6	21	4	2	6	13	4	5.58	119	16	3
1921 - -	11	18	7	22	17	8	22	10	11	0	6	9	0.31	108	0	0
1922 - -	10	10	7	19	2	5	20	18	6	−1	16	1	−1.61	104	12	6

During the War period both labour and other working costs increased considerably, labour costs reaching their maximum in 1920, and the total working costs in 1921. There was a sharp rise in prices in 1918, causing the net return to the producer to jump up to 15 per cent. on the capital invested. With an intimate knowledge of the agricultural conditions, it was an easy thing to adjust, fix and control prices on a reasonable and just basis, with the result that during the four War years, 1915-1918, the farmers' net returns averaged only 9.84 per cent., and there was no very great and abnormal rise in the cost of living. After the War, came the slump and the agricultural crisis; but a

crisis easily tided over. In 1922 there was a loss of 1.6 per cent. on the capital invested—our results in Yorkshire showed an average loss of 17.7 per cent. during that year, and a loss of more than one quarter of the farmers' capital in the two big years of the slump. In Switzerland there was no big inflation during the War, and in consequence no big deflation afterwards.

Possibly it may be urged that the "extensive" system of costings is of more value from the national than from the individual standpoint, but it certainly has its advantages, and while we in England would be very ill advised to cut down in any way the "intensive" system we have adopted, it certainly does seem to the writer to be desirable to undertake in addition a simpler "extensive" system, modified more or less on the methods of Dr. Laur.

Although Swiss records go back to 1901 and relate to some 6,000 holdings, only six farms, as far as the writer could see, are being at the present time completely costed. While, therefore, the position of the industry as a whole is known, very little detailed information is available as to the costs of production of the various farm crops and produce, still less as to the factors which influence the varying costs of production on different farms.

The farms can be and are classified according to the different systems of farming adopted and according to the size of the holding, so that information is readily available as to how far the size of the holding is a factor influencing its efficiency; and as to the type of farm which at the present time is giving the best financial return.

Switzerland is essentially a country of small holdings, more than 83 per cent. of the holdings being under 10 hectares, or 25 acres, and these holdings include 54 per cent. of the cultivated area of the country, if forests and pasturage are disregarded.

TABLE II.
Swiss Results.

Size of Holding	No. of Holdings	Capital Invested per acre	Output per acre	Production Costs per acre	Net Balance per acre	Balance expressed as Interest on Cap'tal invested	Normal Int. per acre on Capital invested per acre	Balance per acre after allowing for normal Interest on Capital
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	per cent.	£ s. d.	£ s. d.
7½ to 12½ acres	662	149 18 8	22 11 7	18 15 1	3 16 6	2.5	6 0 0	-2 3 6
12½ to 25 acres	2 457	116 16 2	19 0 3	14 5 6	4 14 9	4.0	4 13 6	0 1 3
25 to 37 acres	1 367	108 8 5	17 17 2	12 8 11	5 8 3	4.9	4 6 9	1 1 6
37 to 75 acres	1 247	96 11 10	16 2 3	11 1 1	5 1 2	5.2	3 17 3	1 13 1
Over 75 acres	364	75 4 3	13 17 7	9 11 10	4 5 9	5.6	3 0 2	1 5 7

Dr. Laur's results show that in spite of the high gross output from the holdings under 12½ acres their high capitalisation and high labour and other production costs were instrumental in reducing the average net profits obtained on them to less than 3 per cent. on the capital outlay, as compared with more than 5½ per cent. on the holdings of more than 74 acres; from which it would appear that the efficiency of the normal holding increases with its size, certainly up to 75 acres. There is a very marked falling off in efficiency as the holding falls below 30 acres.

No one going over the average Swiss holding could fail to be struck with the size and equipment of the buildings, especially in comparison with the size of the farm. Nearly every farm is equipped with either a "bridge formation," so commonly met with in Scandinavia, or some form of elevator so as to avoid the labour of pitching. Every farm has its liquid manure tank and pump, and in a large number of cases pipes are laid on from the tank to the fields, and the liquid manure sprayed on to the meadow land by means of a force pump at the holding. In one case, from the holding down in the valley, liquid manure was being pumped on to the Alpine grazing land above. While the figures available make it difficult to see how far this heavy expenditure on buildings and equipment is justified by results, some idea of the way in which the farms are being handicapped by having to carry so large a proportion of dead stock, can be obtained from a study of one farm of about 35 acres, more than 30 of which were under grass.

TABLE III.
Capital.

Invested in	Total.	Per Acre.	Per cent.
	£	£ s. d.	
Land	1,692	48 0 0	34.0
Buildings	2,050	58 10 0	41.5
Implements and Machinery ...	452	13 0 0	9.5
Live Stock	650	14 10 0	10.0
Store and Floating Capital ...	250	7 0 0	5.0
Total	£5,094	£141 0 0	100.0

It will be seen that the farm was carrying in the form of unproductive capital (buildings, implements and machinery) a dead weight of more than £71 per acre, representing 51 per cent. of the total capital, and that the buildings, implements and machinery on the farm were approximately one and a half times the value of the land itself.

(To be concluded.)

LUPINS AND LIGHT LAND.

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IN this *Journal* for January, 1920, p. 982, a short account of the value of the lupin to the British farmer was given by the writer, this being a résumé of a paper read at the British Association in 1919. Since then much interest has been taken in the subject and enquiries have been dealt with from various parts of England, Scotland and New Zealand.

It was pointed out in the paper above mentioned that lupins are very valuable amongst cultivated plants in that they may be grown with the greatest ease on the poorest of light land, and that they greatly enrich such land in vegetable matter and nitrogen. At the present time the economic problems connected with the poor light land of this country are quite as urgent as they were in 1920. Large areas of such land are being abandoned as unprofitable for cultivation. Land of this type will not grow grass satisfactorily, except in districts of heavy rainfall—hence the problem is not one of arable versus grass, but of arable versus practically derelict land. Sandy soil which will grow fair crops if under a carefully thought out rotation of light land plants, will, if allowed to go down to grass, produce food worth only a few shillings an acre annually.

Continental Work upon Lupins.—Great interest is taken in lupin growing upon the Continent of Europe, especially in Germany and Holland. In the former country there exists an "Association for encouraging Lupin Cultivation," which has done much to call the attention of the agricultural community to the importance of lupin growing on light land. The valuable work done by Dr. Schultz, at Lupitz, in improving a poor sandy soil by means of lupins was referred to in this *Journal*, January, 1920.

Dr. Baessler, at Kummerow, found that ploughing in lupins more than doubled the crop of rye. In western Bohemia perennial lupins, when planted with forest trees have been found to benefit the growth of the trees greatly during the first ten years after planting.

At the Janikow starch factory in Pomerania experiments were conducted in 1920, with a view to discovering a satisfactory method of removing the poison from lupin grain, four processes being tried. In the report it is stated that lupins which have had the poison removed constitute an excellent food for man and beast.

At the pig feeding station at Ruhlsdorf, feeding experiments with pigs of all ages have been conducted with lupins. Yellow lupins were softened for 12 hours in hot water, in a special steamer, then steamed for 1 hour and afterwards washed for 24 hours in several changes of water. The resulting lupins, from which the poison had been extracted, were mixed with steamed potatoes and the cold mixture was given to the pigs, *ad lib.*, with very favourable results.

Experiments on the digestibility of several lupin products, after their bitterness had been removed, were conducted during 1920-21 at the Wurtemburg Agricultural Experiment Station at Hohenheim. The lupins had been rendered free of bitterness by Prof. Bergell's method, using common salt.

The conclusion was reached that lupin products, deprived of their bitter flavour, form an excellent protein feed, which can be easily kept for a long time, is very digestible both for ruminants and swine, and is almost equal to soy cake in favouring the secretion of milk. The writer is indebted to Mr. E. I. Robson, M.A., for pointing out to him the very numerous references to the value of lupins in classical literature. The writings of Pliny, Columella, Palladius, Theophrastus and others contain observations which show that the value of the lupin was thoroughly understood in ancient times.

Cultivation.—For those who have no previous experience of lupin growing the following brief notes may be of use:—

Lupins are very similar in cultural treatment to spring beans; they are, however, unsuited for growing on heavy land. The land is ploughed, cleaned if necessary, and the seed drilled at the rate of 1¾ to 2 bushels per acre. The rows may be the same distance apart as with spring beans. When grown for seed they are best sown on very poor light land, as under such conditions they ripen better than on good land, and they should, if possible, be sown in April. If sown in March there is danger from frost, while if sown in May the seed may not ripen very well. If sown for green manuring or for folding with sheep they may be sown any time up to the middle, or even the end of July.

Lupins may be horse-hoed, as with spring beans—often, however, this operation is omitted. In fact the land on which lupins are grown is so poor that usually the minimum of expense on tillage operations is incurred. The only further cultivation is to plough the crop in, or to plough the land after folding. Where the seed is harvested the crop is cut with

the binder or side delivery machine (the spiny pods of the lupins are hard on the binder canvases) and harvested exactly as spring beans.

The price of lupin seed, owing to the limited market, is subject to rather violent fluctuations. In February, 1925, growers were able to obtain from 5s. to 6s. a bushel for a useful sample. The yield varies from 20 to 30 bushels per acre, which is quite good considering the extremely poor land upon which lupins are grown.

Effect of the Growth of Lupins upon the Land.—The remarkably good result of a crop of lupins upon the fertility of the land was discussed in the previous article referred to. This beneficial effect is recognised by Suffolk light land farmers. In one case, on the farm of Mr. A. R. Rope, Leiston, Suffolk, it was found that a better oat crop followed where lupins were folded, than where they were harvested for seed.

On the farm of Mr. H. C. Boggis, at Easton Bavents, Southwold, the writer found that oats after lupins folded with sheep, did not give quite such a good crop as oats after lupins ploughed in green, when the whole bulk was available for soil improvement. Where the crop is folded with sheep, a good deal of the organic matter will disappear, being consumed by the sheep, but probably a considerable proportion of the nitrogen contained in the crop will be absorbed into the soil in the dung and urine of the animals.

Where the crop is harvested for seed much leaf and root residue is left upon the land. This is, however, very much less in bulk than the green material ploughed under where the crop is grown for green manuring. Where the seed is harvested the stems and pods of the lupins go to enrich the farmyard manure heap and so are not lost to the farm. It is recognised by all that whether the crop is harvested, or ploughed in green, the soil is greatly enriched in organic matter and nitrogen. In Nottinghamshire, Dowling* has conducted field trials to test the effect of lupins upon succeeding crops. In one case lupins were compared with buckwheat, both crops being ploughed in green.

The lupins grew luxuriantly and kept the weeds down, whilst the buckwheat was practically smothered out by spurrey. Black winter oats were sown soon after ploughing the lupins and buckwheat in, and in the following year were harvested separately.

* Report on Field Experiments, 1921 and 1922, Notts Education Committee.

The oats after lupins yielded 7¼ qr. per acre—those after buckwheat yielded only 1½ qr. per acre.

The following year a portion of the lupined area was sown with turnips without any manure of any kind and gave a crop of 9½ tons per acre. The report states that it was a foregone conclusion that had turnips been sown without manure in an unlupined area there would have been no crop to speak of.

Suitable Climate and Soil Conditions.—As with all other crops, a sufficient supply of moisture to germinate the seed is necessary with lupins. When the crop is sown in April, for seed production, there is usually enough moisture present for this purpose. When the crop is grown for seed production a fair rainfall is beneficial during the summer, but too much rain delays the ripening of the seed, and may cause the harvest to be too late, especially on good land. When the crops is grown for green manuring or for folding, the seed is usually sown in May, June or July, and as the soils on which lupins are grown are usually very light, and retain moisture very badly, there is in some seasons, especially in the dry Eastern counties, some danger that there may not be enough moisture present to germinate the seed. Provided there is enough moisture for this the crop makes a fair growth under rather dry conditions. Should there be an ample rainfall, as was the case in 1924, very luxuriant growth will result, so that an enormous crop of green stuff is obtained.

As has been previously mentioned lupins will thrive on very poor sandy soil, even on almost pure sand, provided there is enough moisture present. It was considered in classical times that lupins do not thrive in the presence of much lime in the soil. This view is confirmed by modern experience. In Suffolk lupins seem to thrive best on soils showing a moderate degree of acidity, on which sorrel and spurrey are fairly abundant. There is, however, evidence that it is possible for a soil to be too acid even for lupins. These plants have been known to fail in small patches in fields, the small patches showing, as indicated by the great quantity of sorrel and spurrey present, a very high degree of acidity.

German writers refer to the necessity of inoculating the seed with cultures of the organism of the root nodules in order to secure satisfactory fixation of nitrogen. From the rather limited experience of lupin growing in this country this inoculation would appear to be unnecessary. Nodules have grown

satisfactorily without any such treatment in all cases which have come under the observation of the writer.

Varieties of Lupins.—The variety most commonly cultivated in Suffolk is the Blue Lupin. This kind grows rapidly, produces a very fair mass of foliage and ripens its seed satisfactorily in an average season if sown in April, provided the land is poor. If the land is too good the seed does not ripen so well. Experiments conducted by the writer with Yellow Lupins led to the conclusion that this variety was on the whole rather inferior to the blue lupin for Suffolk conditions. The yellow lupins are more branched from near the ground than are blue lupins. In Holland it is considered by some that for green manuring a mixture of blue and yellow gives better results than either variety alone.

In Suffolk the large White Lupin has been grown during the past two years, the seed having been imported from Italy. It has been used for green manuring and has given enormous crops of green material, distinctly larger than those given by the blue lupin when grown in the same field. In one case under observation, owing no doubt to the heavier crop of green material ploughed in, a heavier crop of oats resulted after the white than after the blue lupins. It is uncertain whether the seed of the large white lupin would ripen under average British conditions.

Place of Lupins in the Rotation.—Lupins as a seed crop are grown after a cereal, as a rule, and occupy the same place in the rotation as peas or beans on heavier land. When grown for sheep folding or ploughing in green, they may follow a spring or early summer fallow. In this case the lupins are the only crop obtained in the year. When they are ploughed in for green manure, the crop is open to the very grave objection that it gives no immediate financial return. In the present adverse economic conditions of agriculture this is a very serious matter and involves a whole year without any income from the land. In Holland lupins for green manuring are grown after a corn crop. This might be done in the very earliest districts of England, after such crops as rye, winter oats, or early barley. It often happens, however, that when harvest is early, the stubbles are so dry that the seed would not germinate.

The writer has never known a case where lupins were successfully grown after a cereal-grain crop in Suffolk, but it might be done in a favourable season—the stubbles would

want to be clear by the end of July, and sufficiently moist to germinate the seed. There are, however, a number of crops which come off the land earlier than corn, and after which lupins can be quite successfully grown for green manuring. Amongst such crops may be mentioned early potatoes, tares and oats, green rye, trefoil, trifolium, and certain other green crops suitable for sheep folding, for hay or ensilage. It is considered by some Suffolk growers that lupins, sown fairly late, give a heavier crop of green stuff for folding or ploughing in than if sown early—say, in May. Trifolium, sown on oat or rye stubbles in autumn, is a most suitable crop for light land, and on the estate of Mr. Russel Paul, of Sutton, Woodbridge, has been found to be very suitable for growing before lupins. Mr. Gaymer, Mr. Paul's agent, adopted this plan in 1924 on land growing a good deal of sorrel, and distinctly sour. A very fair crop of trifolium was followed by an enormous crop of large white lupins, which were ploughed under in October, as a preparation for oats. In early potato districts also, where the crop of potatoes is removed in June or July, a crop of lupins could undoubtedly follow, and where farmyard manure is scarce, it might prove very valuable to increase the quantity of vegetable matter and nitrogen in the rather light soil which is often suitable for early potatoes.

In one case in Cornwall, lupins were sown during the first week of August, after early potatoes, and a crop weighing 14½ tons of green material was weighed on the 8th November. A crop of this kind ploughed in would make a splendid preparation for the succeeding crop.

Where one crop has already been secured off the land in a given year, the cultivator is more likely to be in a position to sacrifice the rest of the year to a green manuring crop than when the whole year has to be devoted to the purpose. In a mild, showery autumn lupins will grow on until the first frost. There can be no doubt that in many cases such a plan is a very cheap way of manuring the land, especially in the case of fields situated a long way from the homestead to which it is difficult to cart farmyard manure. The expenses on the crop are simply the cost of ploughing, drilling and seed. In many cases this will mean less than the cost of carting and spreading farmyard manure, even if that substance were obtained free of cost.

The Lupin as a Fodder Crop.—As was previously mentioned, lupins contain poisonous properties, and care is necessary in feeding them to animals. They are occasionally made into hay

on the Continent. They are difficult to dry and no case is on record in which they have been made into hay in this country. A small quantity of lupin silage and lupin and buckwheat silage was made in Suffolk.

It had the following composition:—

	Lupin silage.	*Lupin and buckwheat silage.*
Moisture - - -	83.46	80.87
Oil or Ether Extract -	1.25	1.53
Albuminoids - -	3.15	3.46
Carbohydrates - -	4.13	6.23
Fibre - - -	5.94	6.48
Ash - - - -	2.07	1.43

Some of this silage was fed experimentally to a sheep on the farm of Sir G. Manners at Woodbridge and this animal consumed it with no ill effects. There appears to be no reason, therefore, why lupins should not be made into silage and fed to sheep, always bearing in mind the precautions mentioned below, which are necessary owing to the poisonous properties of the plant.

In Suffolk it is the custom for light land farmers to grow lupins for folding sheep upon them. A number of farmers who do this successfully were previously mentioned* and, provided care is taken that the sheep do not go on to the lupins when hungry and that the lupins only constitute a portion of their diet, the risk of loss by poisoning is small.

Long† points out that large numbers of sheep have been affected by lupin poisoning in the German Empire, and that the most harmful species is the yellow lupin, although the blue lupin may also be poisonous. He, however, states that it must not be thought that all crops of lupin are poisonous, as they are extensively grown on the Continent for fodder purposes and are usually harmless. Desiccation does not render the plant innocuous, the seeds and hay being poisonous. In this connection it is worthy of note that Suffolk experience with the folding of sheep on lupins has been almost entirely with the blue lupin. In one case in which large white lupins were folded symptoms of poisoning very quickly arose, and the sheep had to be removed.

Long also states that much loss has occurred in America from lupin poisoning with sheep, and that sheep may become gradually immune to the poison by eating lupins regularly.

* This *Journal*, Jan., 1920.

† H. C. Long, Plants Poisonous to Live Stock, 2nd Edition, Cambridge University Press.

He mentions that lupins are far more dangerous when they bear ripe seed. Cut and made into hay before the pods form they are much less dangerous.

The lupin does not appear always to be poisonous—but only under certain conditions, which are not too well defined. Marsh and Clawson found alkaloids to be the cause of the trouble. Chesnut and Wilcox give the symptoms, as acute cerebral congestion, with great mental excitement, the sheep rushing about and butting into things—following is a stage characterised by irregularity of movement, violent spasms and falling fits. The convulsions resemble to some extent those caused by strychnine.

In spite of the somewhat alarming accounts of loss from lupin poisoning in other parts of the world, the Suffolk farmer has no hesitation whatever in folding his sheep upon blue lupins provided certain precautions are taken. It is important that the folding of lupins should be begun gradually, especially if much seed be present in the pods. If this precaution is neglected the sheep become paralysed. It is also undesirable to fold pregnant ewes upon lupins. It is considered that lupins fed in summer help to expel intestinal worms. This opinion was also held by classical writers.

Mr. S. R. Sherwood, the well-known Suffolk sheep breeder, of Playford, Ipswich, in a paper which he read at the International Conference on Sheep-Breeding, held at Derby in 1921, referred to the value of the lupin. He said: "It is not a high-class feed but it has this great advantage—it will flourish on the very poorest light land. No stock with the exception of sheep will eat it, and even they will only nibble it for the first day or two; but when accustomed to it, they will eat it readily. I know no better crop to plough in as green manure."

Lupins may be grown alone for folding, or they may be mixed with other plants suitable for sheep feed. If this is done the danger of poisoning will be greatly reduced, and may disappear altogether. A mixture of oats, tares and lupins has been found suitable for sowing fairly early. For later sowing tares, rape and lupins make a very good mixture.

A seeding of 1 bushel of lupins per acre drilled in, with 2 lb. per acre of rape and 2 lb. of white turnip seed has been found successful for June or July sowing. A mixture of 1 bushel of lupins and ½ bushel of buckwheat per acre was also found to produce a useful crop for folding purposes on very poor sandy

ground, in some experiments conducted by the writer. This mixture came up much thicker than a piece of the same field sown with 2 bushels of lupins per acre. In the dry season of 1921 it was sown on 22nd June and on 2nd September gave 5 tons 2 cwt. of green stuff per acre, although hardly any rain fell during this period.

Utilisation of Lupin Grain.—The cultivation of lupins in this country is severely handicapped by the violent fluctuations which take place in the price of lupin grain owing to the fact that the only market which exists for it is for seed. Once the demand for seed is satisfied, the grain sometimes becomes extremely cheap and almost unsaleable. The limited area under lupins and the influence of season also tends to cause the seed to be very dear one year and very cheap a year or two later.

A few Suffolk flockmasters use the grain for feeding to sheep when it is cheap. From ¼ lb. to not more than ½ lb. per head daily has been found to be safe. More than this quantity causes paralysis. In any case untreated lupin grain should not be fed to pregnant ewes. The work done at Continental research stations upon the removal of the poisons from lupins has been previously referred to. The conclusion arrived at—that lupins deprived of these poisonous properties are almost equal to soya cake for milk production—is of considerable economic importance to owners and occupiers of light land in this country, and also to manufacturers of cattle foods, cakes, etc.

There would appear to be no reason whatever why lupin grain should not be treated by one of the processes mentioned previously, so that its poisonous properties were removed, and then sold as cattle food. The process could probably be best carried out on a large scale by manufacturers of cattle food. There can be very little doubt that occupiers of poor light land would be prepared to contract with cake manufacturers to grow lupins, in the same way that sugar beet growers contract with sugar factories.

The matter seems to be well worthy of the attention of both cake manufacturers and farmers, and if such a scheme could be started it would greatly increase the productivity of poor light land, by providing a ready market for one of the few crops which will grow upon it. It would also benefit cake manufacturers and agriculturists in all parts of England by introducing a new and very valuable home-grown cattle foodstuff to the British market.

Lupin Meal as Manure.—It has also been suggested to the writer that lupin meal would have a considerable value as a manure if the process of extracting the poison from the grain were found to be impracticable.

It is possible that the oil present in the grain—4 to 7 per cent. according to Kellner—would be worth extracting. If this were so the residue would be very valuable as an organic nitrogenous manure similar to rape cake.

Lupin grain in its original state contains a very high percentage of albuminoids. Very few analyses, however, are available. Kellner gives 29 per cent. of albuminoids for white and blue lupins and 38 per cent. for yellow lupins. Other Continental workers give 41 per cent. Taking an average figure it is quite evident that about 5 per cent. of nitrogen would be present, *i.e.*, a similar quantity to that present in rape cake. An oil-extracted meal would contain a rather higher percentage.

Summary.—The value of the lupin is by no means sufficiently understood in this country. Like all leguminous crops it is able to assimilate the nitrogen of the air and enrich the soil. The lupin is, however, specially valuable in that it is one of the very few plants of economic importance which will thrive on light land poor in lime.

When grown on such land, whether for seed, for folding, or for ploughing in green, the soil is greatly enriched and almost always gives far better crops for one or two years.

Owing to its poisonous properties, care must be taken when folding the crop, or feeding the grain to sheep—which are the only farm animals for which the untreated grain is at all suited. Several processes are used on the Continent whereby the lupins are deprived of their poisonous properties. It appears that when treated by these processes the lupins are quite safe to feed to all classes of stock, and constitute a valuable food rich in albuminoids.

If cake manufacturers in this country arranged to prepare lupins for stock food in this way, a ready market would be always available for the sale of lupin grain. This would be a great benefit to the grower and would increase the productivity of poor light land, by encouraging the growth of lupins. The introduction of a new cattle food, rich in albuminoids would be of benefit to all agriculturists. There is also a possibility that the manufacture of an organic nitrogenous manure from lupin grain might prove profitable.

THEORY OF EXPERIMENTAL ERROR.

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THE agricultural experimenter is inclined to bring the charge against the statistican that he delights in playing with the figures that experiments provide, but that he does not understand much about the plants and animals that supply those figures, and therefore that he cannot criticise adequately. The statistician is inclined to bring the charge against the experimenter that he does not mind how his experiment is arranged so long as he gets a figure. He neither knows the trustworthiness of this figure nor how to ascertain its trustworthiness.

It is important therefore for all who are concerned with agricultural experiments to make themselves familiar with the theory of probable error, and find out what the statistician wants to do and whether it can be carried into practice.

I propose to treat this subject from the strictly practical point of view and to deal with statistics not for their own sake but only in so far as they will help with our work. I also wish to make it clear that I do not seek in any way to give advice, but only to give some account of the theory of probable error.

Chance Errors with Single Plots.—In seeking material on which to base this lecture I came to the conclusion that the facts brought out by the work of Sir Daniel Hall and Mr. Mercer fourteen years ago would best suit my purpose. The experiment on which the whole of this lecture is based is a perfectly simple one. An acre was marked out on a field of mangolds. That was divided up into small samples, and those samples were separately studied to find out how variable the yield could be on different parts of the field because of the influence of soil, insects, clumsy workmen, bad seed drill, or any other circumstances. At the expense of wearying you with repetition, I should like to explain how this work was conducted.

An acre was divided into 10 parts one way and 20 parts another way, thus giving 200 plots, each measuring 1/200th of an acre. On each of these plots the roots were lifted, cleaned and weighed; the yield on one plot was 376 lb., on another 371, on another 355, and so on. Now, the first thing we have to do is to collect together those results in a convenient way; we have to discover how they are scattered about. The most convenient way to study

* Paper read at the Conference of Agricultural Organisers, Oxford, April, 1925.

the scatter is this. Collect the results together into 10-lb. groups, and ascertain the number in each group as follows:—

Group.	No. of plots in group.	Group.	No. of plots in group.
From 260 to 269 lb.	1	From 330 to 339 lb.	39
„ 270 „ 270 „	2	„ 340 „ 349 „	30
„ 280 „ 289 „	2	„ 350 „ 359 „	18
„ 290 „ 299 „	9	„ 360 „ 369 „	8
„ 300 „ 309 „	23	„ 370 „ 379 „	3
„ 310 „ 319 „	24	„ 380 „ 389 „	1
„ 320 „ 329 „	40		

The biggest group was comprised of those plots whose yield was between 320 and 329 lb.; there were 40 such plots. The next group contained 39 plots. A number of causes may have been responsible for the plot which gave the lowest yield of 267 lb. For instance, the drill when sowing this plot may have been clogged. Similarly, the plot which gave the highest yield of 384 lb. may have been on the site of last year's muck-heap—no one knows the favourable circumstances. The true average for the yield of all the plots was 328.6 lb.

Now, as Sir Daniel Hall pointed out in the previous lecture*, the most convenient way of dealing with this grouping is to make a curve (see p. 328). Take the base line as the yield line and mark off the yields at 10 lb. intervals along it. Draw vertical lines at each 10 lb. interval corresponding in length to the number of results within the 10 lb. group and join the points so obtained to make the curve. This curve represents in a convenient way how the yields of the plots are scattered about.

We must next proceed to make certain deductions from this curve. The first deduction is that if you put down 200 plots of mangolds on this field you will have yields ranging from 267 to 384 lb., and the particular result you get from a single plot will depend on the position of your plot on the field. You will make the criticism that you would not put down so small a plot as 1/200th acre: your plot would be larger. If you take larger plots, your work will be more reliable, but you will by no means escape from the problem. These results show the danger of arguing from a single plot. If you take one plot you have only one figure and nothing by which to check it. If you have several plots of the same kind you have several figures and are in a position to make some sort of check. One figure can never check itself, and that is why, in principle, the single plot must come under suspicion. One of the purposes of this theory of probable error is to show how many plots you need in the sample you take from your field, to get any desired degree of reliability.

* This *Journal*, June, 1925, p. 202.

The probable error theory will also show, for example, how many bullocks you would have to feed on a certain ration to determine the value of that ration with a given degree of accuracy. Let us examine the plot figures in another way. Suppose that in a hat are 200 tickets on which are written the yields from the 200 plots. Putting down plots on the field is like drawing tickets from the hat—you draw one or more tickets, chance decides what particular values you draw, and separate draws or sets of draws may give very different values.

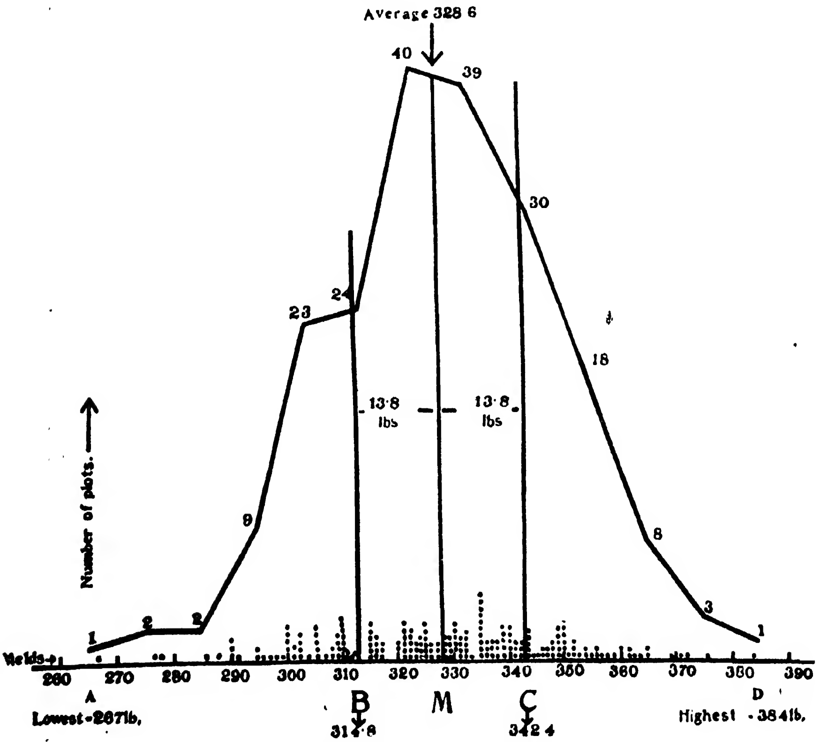

FIG. 1.—Showing yields of the 200 small Mangold Plots.

It is not in the least stretching the comparison to say that putting down a single plot on a field is just as objectionable in principle as trying to tell the average value of tickets bearing these different yield numbers by drawing from the hat any one of the 200.

It will be seen from the curve in Fig. 1, that of the 200 plots, 40 lie between the values of 320 and 329 lb. There are thus 160 in the other groups. Now if you dip your hand into the hat the chances that you will draw a ticket whose value lies within the 320-329 lb. group are as 40 is to 160, *i.e.*, the betting is 4 to 1 against your drawing a yield within this group.

In the same way you can find the betting on drawing out of the hat a ticket whose value is less than, say, 310. This is the same problem as going into the field, putting down a 1/200th of an acre plot, and of the chance that the yield from it will be less than 310 lb. Thirty-seven tickets have values less than 310. The chances against your drawing a value of less than 310 are 163 to 37, or $4\frac{1}{2}$ to 1. That is a simple thing to understand and is the whole principle on which probable error is based.

How Probable Error is Found.—Now the true average of the yields of the 200 plots is 328.6 lb. If you go downwards through the fifty yields next below the average in order of yield, you will come to a value of about 314.8 lb., and if you take the fifty plots in ascending order of yield above the average you will come to a value of about 342.4 lb. Half the plots therefore have values between 314.8 and 342.4 lb., *i.e.*, half of the tickets in the hat have values between about 314 and 342. It is therefore absolutely even chances that if you pull out one ticket its value will lie between 314 and 342 lb.

Now these two points are very critical ones. Half of our plot values lie within a range of 13.8 lb. above and below the true average; and this 13.8 lb. is called the probable error of a single plot-yield. There is nothing more magical in probable error than that. To find probable error, then, make a number of measurements of the same kind, find the average, and the interval above and below the average within which half your results lie is the probable error. As it is even betting that any single value will lie within this range it is obvious that the probable error gives some idea of the reliability of your results.

How do we find the probable error in practice? In experiments we can very rarely get 200 measurements of the same thing. We usually have to content ourselves with a much smaller number of observations. The simple method of finding the probable error that I have outlined is not the most convenient. We have therefore to rely on the theory of the laws of chance.

In the first place we must recognise that in our measurements we shall always get a scatter of values as indicated by the frequency curve. In the next place we must recognise that when pure chance operates, we get the same scatter of values. Let me demonstrate this point. Let us consider the results we may get by spinning ten pennies. It would clearly be possible to get ten heads, or nine heads and one tail, or eight heads and two tails, . . . five heads and five tails, and so on, to no heads and ten tails. Once in 1,024 times you would get ten heads, once in

1,024 times you would get ten tails; the most common result would be five heads and five tails; the next most common would be four heads and six tails or six heads and four tails, and so on. The frequency curve in this case where pure chance operates would be very similar in essential form to that we have been considering for experiments. By this similarity the idea of probable error in experimental work was suggested.

Imagine ten possible causes controlling the yield in our experiments and suppose each could have only a high or a low value corresponding to the head and tail of a penny. Then it is 1 : 1,024 that all ten causes will operate at high value on any plot. There are many chance differences in the circumstances by which yield is controlled. Generally speaking, agricultural experiments give you a scatter of values which resembles that which you get when chance operates.

The curves of pure chance are not all the same, any more than the curves of experimental values are the same, *e.g.*, the curve for tossing 10 pennies differs in actual shape though not in essential form from that for tossing 20 pennies. If you had put down potatoes on the plots on the mangold field the curve of yields would have the same general form but not the same shape; it might be taller or flatter for example. As the general form of the pure chance curve is the same as the general form of the curve of values in agricultural experiments repeated many times, we are justified in using anything the mathematicians deduce as to chance curves to help us in interpreting the curves of values we get from our agricultural experiments.

I want to speak only of two mathematical deductions that the statistician makes from his chance curves. He has a convenient formula rendering unnecessary the counting of plots above and below the average, so that in practice to get the probable error from any set of experimental results we use this formula. The other deduction is that the odds are about 20 to 1 that if you take any single value from a whole set of values (or if you take any single ticket from the hat) it will lie between the limits of three times the probable error above the average, and three times below. Now 20 to 1 is pretty long odds, so it has become customary to accept this range of three times the probable error above the average and three times below the average as the interval in which we can reckon practically all our values will lie. Correspondingly this interval represents the total range about the true average over which we must expect single plot values to be scattered. It is the " margin " we must allow for " chance " errors or differences.

Size of Plot.—I must now refer to the effect of the size of the plot you use. I can compress the whole matter into this form. If you take very small plots you get large probable errors. If you take larger plots your probable error grows less. The effect of the size of a plot on the probable error has been carefully worked out, and two distinct facts emerge. The first is that the size of about 1/40th of an acre is the best. Above 1/40th of an acre the probable error does not fall very quickly with increase of size. Even with 1/10th of an acre plots the probable error is very considerable. It is convenient to put the probable error as a percentage of the true average, and with 1/10th acre plots it is 3 per cent. of the true average. That is to say that if you were to put down, say, 100 1/10th acre plots of a certain variety of wheat the betting would be 20 to 1 that any single result will lie inside the range of from 9 or 10 per cent. of the true average above that average, to the same distance below that average. That puts the state of affairs as regards a single plot. Whether we like it or not, we have got to allow for a deviation from the true average of 10 per cent. up and 10 per cent. down on the single plot. A bigger plot does not help very much. The probable error of even an acre plot is of this order.

Number of Plots.—It will be evident that a single plot experiment has a very low reliability. I think I shall be quite well understood if I say that to publish the yield of a single plot without disclosing at the same time the uncertainties attaching to that yield is, to put it at its lowest, very misleading. If you grow only a single plot then you have this wide range of possibilities. Well, common sense says why not put in a number of plots and take the average. Suppose you put in sets of five at a time, and repeat your sets. Your average yield (from 5 plots) will differ each time, but the scatter will be less, the probable error less and the reliability greater. The whole thing can be crystallised in this way. The probable error enables you to appreciate how much more reliable an average is than a single plot. The probable error of a single plot turns out to be, say, 13.8 lb. If instead of taking a single plot you take the average of five plots, the statistician would tell you that the probable error of the average of five plots is 13.8 divided by the square root of five, for ten plots it is 13.8 divided by the square root of ten. The probable error of the average is the probable error of a single plot divided by the square root of the number of plots on which you base your average. This shows how the probable error is dependent upon the number of plots that contribute to your

average. I should mention that if you take plots of (say) three varieties of wheat a good deal turns on how you arrange these plots with regard to each other. I am, however, unable to deal with the question of arrangement here.

Probable Error of Differences.—I have one final point to deal with, and it is the most important. It is the probable error of a difference. In our experiments everything turns on differences. We want to know the difference between two varieties of wheat or two pig rations. Suppose you were testing two wheat varieties, and had five plots of each; you would find the same scatter of individual differences about the average difference that we have dealt with above. There is a simple formula for finding the probable error of the difference between two averages. Let us suppose that the average yield of 10 plots of 1/40th acre of Squareheads Master is 68 lb. and of 10 plots of Yeoman 62 lb. Is the difference of 6 lb. significant? Our formula gives us the probable error of this difference as 2.5 lb. Thus the margin we must allow for differences produced solely by chance (dissimilar soil conditions, etc.) is $3 \times 2.5 = 7.5$ lb. Our difference of 6 lb. is not safe therefore. We can only say that possibly it simply represents chance effects. The rate of yield per acre is about 43 bushels of Squareheads Master and 39 bushels of Yeoman. The difference is 4 bushels to the acre; but our examination has shown that the difference is not statistically reliable.

Summary.—Let me recapitulate the more important points. The first is that single values in any experiment cannot be depended on. Possibly, however, you may only be able to get a single value. Perhaps there are circumstances in which you cannot put down a number of plots. This from the point of view of accuracy is a disadvantage, but single plots of each of three varieties may give useful information such as resistance to drought, lodging, sprouting in the stook, etc. It is a waste of time, however, to weigh the produce from a single plot. In the second place it is not justifiable to give the result of an experiment even if it is an average result, unless the reliability of the result is defined by the probable error. Next, a difference is not reliable unless it is at least three times the probable error. Lastly all the help that statisticians can give will never take away the necessity for careful handling of plots.

I would like to suggest that a common cause of error and weakness in experimental work is the temptation to try to include too much in the experiments. If instead of attempting to measure the yields of twenty varieties of wheat you measure those

of four varieties you have five times the number of observations, and the reliability of results will have been increased correspondingly without any additional work. The practical deduction is to reduce the number of points tested and so increase reliability in experiments.

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APPLE PACKING IN WASHINGTON AND OREGON.

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WASHINGTON STATE lies immediately to the south of the Okanagan Valley of British Columbia, and for apple production is one of the most important in America. It is the area in which box packing was first started and where this system has been most developed.

Entering the State at the port of Seattle on the Pacific Ocean, it would appear that the district usually experiences a heavy rainfall, but the fruit area is some 150-180 miles inland, over the Cascade Mountains, where the valleys look as dry as dust and the mountain sides produce little beyond backed-up bunch grass. At Wenatchee a number of these waste and barren valleys, all having an elevation between 700 and 1,000 ft., have been made fertile by a great scheme of irrigation whereby the snow water from the mountains is captured and led to water the soils over a hundred thousand acres in extent, of which nearly 40,000 acres are planted to fruit. Immediately south of these valleys lies a range of high mountains, and then comes the Great Valley of the Yakima River, in which more than 40,000 acres of fruit, in one continuous stretch, have been planted on the hilly slopes, with asparagus, lettuce and other vegetables on the lower parts by the river. These two areas of Wenatchee and Yakima have an annual production in apples alone exceeding 15,000,000 boxes, and the districts are known amongst apple distributors the world over. The next important apple district in Washington State is that of Spokane with an acreage nearly equal to that of Yakima, but the soils have proved less suitable and the total production is much less.

On an upland region of rolling hills at Walla Walla there is a fourth important area and many smaller and less important ones in other valleys. In fact, wherever it has been found possible to secure adequate supplies of water by irrigation schemes, apple

producing industries have sprung up and swelled the annual production of this State to nearly 20,000,000 boxes. All the fruit is packed in boxes.

The towns of Yakima, Spokane and Wenatchee are small and even with the growing and industrious port of Seattle the population of the State is only 1⅓ millions, so that a very small proportion of the apples are required for home use, and the vast majority have to be sent away by rail over the high Rocky Mountains and across the prairie plain of Central America to the eastern towns of Chicago, Detroit, Minneapolis, Philadelphia and New York, or by rail to Seattle for shipment via the Panama Canal to England, Germany and Scandinavia.

The distributing systems which have been established at Wenatchee and Yakima have all been framed to supply apples at short notice to any markets in the world. The farms in all these areas are small, most of them averaging not over fifteen acres, and many less, so that it would be impossible for any one grower to market his fruit individually or, in the case of some, to undertake the grading and packing.

At both Yakima and Wenatchee fruitmen with business talent have built up during the past twenty years an extensive business in shipping apples to distant markets; some buy the apples from the growers, already graded and packed, others prefer to buy the "orchard run" apples in boxes, and carry out the grading and packing with their own staff. These independent shippers handle seventy-five per cent. of the crop and appear to be making a comfortable living from the business. The remaining twenty-five per cent. is sold for the growers by one or other of the Growers' Associations or Unions which have been created.

In this State it has been difficult to trace the origin and progress of the Association movement, because of its varied results. Some Growers' Associations formed in the early days have either failed or been repeatedly reconstructed, while a few have made good, so that no continuous line of either failure or progress can be recorded. At Yakima about 20 per cent. of the growers have joined in forming two distinct associations for the handling of the fruit crops, each about the same size—one known as the big Y or The Yakima Fruit Growers' Association, and the other known as the County Horticultural Union.

Yakima Fruit Growers' Association.—This Association, now popularly known as the Big Y (for that is the brand on the labels), was organised in 1911 as a co-operative association for

the purpose of improving the production, packing and marketing of the fruits from the orchards in the Yakima Valley, but has undergone a number of changes in both policy and personnel. It was re-organised in 1918 along the present lines, which are said to be well adapted to the needs of the district. It has 1,000 members, each of whom must hold not less than a $10 (£2 10s.) share, and it is registered as a Joint Stock Company with a capital of $350,000 (£80,000). Though a co-operative association, it has centralised management with authority vested in a Board of Directors, and its operations are carried on by a permanent staff of employees.

The area in which this association works extends from Selah at the top right down the valley to Kennewick, a distance of approximately 125 miles, so it became necessary for the association to establish fruit-packing stations all down the valley at nearly every railway station where the fruit could be delivered conveniently and packed on communal lines. There are no local associations of growers in charge of the management of these local houses as in the Okanagan Valley of British Columbia. The general policy is conducted by the Central Executive and enforced by a packing-house superintendent in charge of all the houses—though each is under the care of a local manager or foreman. The houses are of different sizes to meet the requirements of the respective areas, and of varying shapes influenced by the land available at the rail stations. The house at Gleed is said to be typical of the district. It is situated alongside the rail lines and constructed of wood—not luxurious but practical, roomy but not artistic. It is divided into four distinct portions —the platform (80 ft. by 20 ft.) on which the fruit is received before grading; the grading room (80 ft. by 20 ft.) in which the grading and packing are performed; the temporary store (80 ft. by 80 ft.), and a frost-proof store (900 ft. by 60 ft.). In addition there is a basement under the frost-proof store in which the orchard run fruit is stored before packing.

Method of Grading and Packing.—The growers deliver the orchard run fruit in new standard boxes to the receiving platform, where it is checked and the record entered in books, and a preliminary receipt handed to the grower. After being checked it is conveyed automatically either to the basement for storage or to the grader for handling. Here the fruit is fed on to the sorting table of a Cutler machine, where it is conveyed by belts past the sorters. These sorters (16 girls) sit where they can see every apple as it passes and grade it, as to colour and

condition into Extra Fancy, Fancy, C. Grade, or Culls, by placing the apples on to the conveyor belts for those grades. Each grade of fruit then passes to the sizing machine, which weighs each apple, and distributes it according to its weight to one or other of the twenty bins alongside. The packers (5 men and 5 girls) wear cotton gloves to prevent injury to the hands and take the apples from the bins, wrap them in paper and place them in boxes which have been passed overhead on an automatic conveyor before being emptied on the sorting table. The number of sorters appeared excessive, but the writer was told that only by using a large number of sorters could a high standard of grade be maintained. The packers worked very quickly and were said to average 150 boxes each per day, making a total daily output for the house of 1,500 boxes, a speed which is kept up day by day, week by week, as long as the crop lasts. Generally, the Gleed output is 100,000 boxes per year. The packed boxes are put on to gravity conveyers and taken to the press at the end of the room where the boxes are lidded, stamped with grade, number of packer, number and variety of apples, etc., and then passed into the next room for checking and storing. Besides the sorters and packers there are truckers, dumpers, lidders, labellers and a receiving crew to check the fruits, making a total force of nearly fifty people.

The other thirteen houses work on similar lines, though in some of them fruits such as Bartlett and Beurre D'Anjou Pears, Elberta Peaches, Prunes, Apricots, Bing Cherries, and Clark Seedling Strawberries are packed in addition to the apple crop.

Storage.—Four of these packing houses have been provided with cold storage plants, so that the crops can be cooled before shipment, or when the markets are glutted the packed boxes from all the packing stations can be held over and marketed to better advantage.

At Kennewick, at the eastern end, there is a cold storage capacity of 80,000 boxes; at Zillah a very large plant with cold storage capacity of 375,000 boxes; and at Sawyer for 65,000 boxes. In these three, and in the Yakima house, the Association has cold storage capacity for 500,000 boxes. The cold chambers are used also for cooling peaches, strawberries, etc., before shipment. In the case of pears, the fruit as soon as received from the grower is sent to the pre-cooling room, where it is kept in a very low temperature for a sufficient time to cool each pear thoroughly to the centre, thus checking the ripening period. After being pre-cooled, the pears are passed through

Fig. 1.—The Packing House of the County Horticultural Union, Yakima, showing four Ideal Graders.

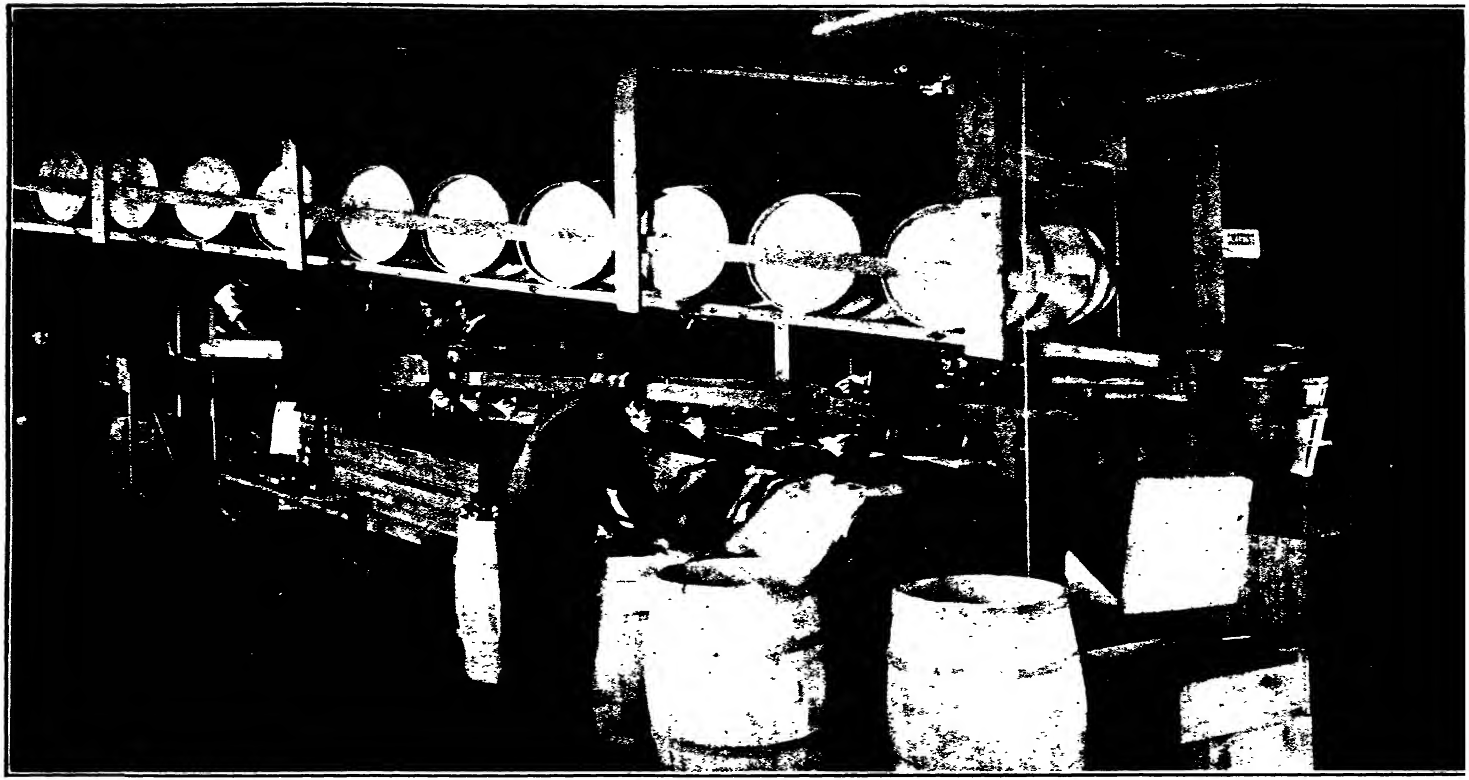

FIG. 2.—Connecticut Valley Orchard Co., Westminster, Vt., Showing 2-Section Model "B" with Barrel Tray Bins in Second section.

the grading and sizing rooms, packed and passed back into cold storage until shipped to the market.

Such is the way that the fruit of 85 per cent. of the members of the Yakima Growers' Association is dealt with at a cost per box of apples of 1s. 7d. for packing, paper, etc., 3d. for overhead charges, 2d. for warehousing and cold storage, together with a selling charge of 4d., making a total charge of 2s. 4d. per box.

Payment and Advances.—Growers are furnished with spray materials, and other orchard supplies, up to the probable limit of the seasonal requirements at current prices without interest. Pre-harvest advances, for thinning and other orchard operations, in limited amounts, are made, these advances being secured on growers' notes. Upon the delivery of the fruit to the warehouse, other advances are made on a fixed schedule, in amounts depending upon the growers' needs and the standing of individual accounts. Not infrequently growers receive the larger proportion of the money coming to them long before the closing of the pools. Soft fruit pools are short-time pools, that is weekly, or semi-weekly, while practically all apple pools are for the season. Payment on the pool system was explained in an article in this *Journal* for Feb., 1925, page 1,044.

Horticultural Union.—The Horticultural Union at Yakima markets about the same quantity of produce as the Big Y, though its membership list is barely five hundred. It is a company of long standing, registered as a Joint Stock Company with $500,000 capital of which fully 86 per cent. has been subscribed by its present shipping members. Its annual business exceeds $3.000,000 (£600,000).

The policy of the Union is determined by a Board of Directors and its business transacted by a Manager, Accountant, Warehouse Superintendent, Inspectors and packing-house staff. The Union has been formed more for the purpose of erecting cold storage plant and as a selling agency than as an organisation to undertake packing, though to some extent that also is done. Two-thirds of the fruit handled is. however, packed by the growers in their ranch houses on standards fixed by the Directors of the Union, but these boxes are inspected before they are taken over for storage by the Union, and in that way the Union is able to maintain an even grade in the absence of central packing. For the benefit of the smaller grower, seven packing houses have been established at various centres, in which communal packing is practised much in the same way as has been described

for other houses, though most of the grading and sizing of the apples is done by hand.

Method of Grading and Packing.—The packing room at Yakima is very large, well lighted with glass side lights near the roof, and equipped with most complete machinery for the automatic handling of box fruit Five Ideal grading machines have been installed quite recently to facilitate the work of sorting the fruit into grades and sizes. The Ideal machines work very silently, being simply constructed of a series of long moving conveyors indented at every 6 in. with holes ½ in. deep into which each fruit is placed by the sorters. With this machine the sorters have to handle every fruit and place each one into a hole on the proper band. The fruits travel down the table on the moving bands and pass under other bands which move at right angles; the latter are set at varying heights along the table so that the large fruits are sent into the first bins and the rest pass on, being cast into the bins automatically in accordance with their size. The fruits are set into the holes of the bands on their sides, so that when shot into the bins there is little risk of any stem injury, and for that reason the Ideal is said to be a good machine for grading and sizing apples with long stems and soft pears. The machine is slower than the Cutler machine and sizes irregularly shaped apples less perfectly, so that the girls can pack less rapidly, but has the advantage of being much quieter and rather cheaper. The apples are packed into boxes from the bins and then taken on elevators into the adjoining cold storage rooms where 400,000 boxes of apples can be held at 32 to 33° F. for weeks on end.

The cold storage plant is worked on the compressed ammonia principle, and is in almost continuous use. Elevators have been run through every chamber of the cold stores so that fruit from the packing shed may be run to any part of the storage building; or from any part of the storage building away out to the railway platform right into the railway car for loading. Little man handling is necessary, the elevators doing the work more quietly and at less expense.

Marketing.—The Union has adopted a label for its boxes which is now recognised as a symbol for good packing throughout the States. The Blue Ribbon Brand, The Red Ribbon Brand and The White Ribbon Brand designate the three grades of fruit marketed, and on account of its reputation the Union is able to sell practically its whole output at f.o.b. price at Yakima to merchants situated in the distant markets of the great towns of the States.

The Horticultural Union works very efficiently and cheaply, for the cost to members for packing, storing and selling is but 2s. 0½d. per box of apples. Naturally, such a successful association has little difficulty in keeping its old members or in securing new members, though in practice the Directors have not found it the best policy to take every additional member as soon as he makes application, but to place his name on a waiting list for admission to the Union as soon as the expanding business of the Union safely permits the management to deal with a larger supply of fruit. The waiting list at the present time exceeds in number the present list of members, so that in a way it seems to be a respected privilege to belong to this well-managed, though somewhat conservative, co-operative union.

The Big Y and the Horticultural Union are in practice Joint Stock Companies, with a well-defined business in packing, storage and selling, though they work on co-operative lines for their members, no profits can be made, and the growers receive the actual selling price, less the cost of packing and storage and the overhead charges of the central organisation. Both organisations sell the fruit at f.o.b. rates at Yakima, and leave to the purchaser the responsibility of feeding them to the market. At times fruit is sold by one of these companies to wholesale merchants in Yakima who probably are, or think they are, in a position to place a particular lot in the market to better advantage. The associations have apparently made no attempt to deal with the question of "Orderly Marketing" beyond the methods adopted by the average independent shipper, nor has it been possible to form any working arrangement with distributors in the great fruit markets other than those open to the large independent shippers.

In effect, the Growers' Association and the Horticultural Union have displaced a number of independent shippers at the producing end and are now trading on much the same lines and in much the same way that an independent shipper does. Both organisations have, however, taken a real live interest in protecting the growers' interest, and in looking after the fruit industry in the broadest sense. They have done much to stimulate the best methods of culture, encouraged the thinning of fruits, and the spraying of trees to keep down pests, and have developed the grading and packing of fruit to a high standard.

It is in these technical achievements that the associations have proved so valuable rather than in securing for the grower a greater portion of the price ultimately paid by the consumer.

The Hood River Valley, Oregon.—The growers in the Hood River Valley were the pioneers of the export trade in box apples to Great Britain, which business they have developed since 1901 until at the present time about one-third of the total crop—600,000 boxes—is marketed in Great Britain.

Though less than one hundred miles distant from the Yakima area, the Hood River Valley is not comparable with the apple regions of Washington or British Columbia. Instead of a dry climate, it has a rainfall equalling that of Kent. The trees have a different habit of growth and lower average yields are obtained than in most other apple sections of the North-west Pacific States. The lighter yields are very largely accounted for by the fact that Yellow Newtown and Spitzenberg, well known for high quality but rather shy bearing varieties, predominate.

The area is very compact, being situated in a valley some 8 miles wide and 25 miles long, stretching from the Columbia River to Mt. Hood. This mountain of the Cascade Range is covered with snow, so that plenty of water is available and summer irrigation of the orchards is generally practised.

The growers have not neglected other kinds of fruit, and an extensive business in strawberries and Bartlett and Beurré D'Anjou pears has been built up. Recent plantings are to pears rather than apples, for great difficulties have been experienced in the last few years in producing the latter at a profit. The fruit produced throughout the whole valley must come by rail or car into Hood River town on the Columbia River for shipment by rail to the eastern towns of the States. or by rail westward for 60 miles to Portland for shipment to Great Britian via the Panama Canal. Practically none of the fruit is required locally.

These conditions naturally brought into existence a number of shipping merchants who purchased the packed boxes of fruit from the growers and marketed them on their own account; but as early as 1891 some of the growers formed a Growers' Union, which after a series of changes and developments has now emerged as the Hood River Apple Growers' Association, a first class organisation of growers which has established cold storage accommodation for the fruits and which also acts as a selling agency for most of the fruits produced in the valley. It is said to handle at least 85 per cent. of the total fruit crop of the valley, and has an annual turnover of nearly $3,000,000 (£600,000).

The actual packing of the fruits is done in most instances on the farm ranches, where nearly every grower has his own small packing station where bench packing is done. Only a very few have fitted graders of either the Cutler small machine or the Ideal. The packing, however, has to be done to standards set by a Growers' Committee of the Association: and before the fruit is accepted for storage or for marketing it is inspected by field inspectors who are employees of the Growers' Association. There are many who have doubted the possibility of maintaining a level standard of pack on a system of farm packing, but the experience of this Association shows clearly that a level pack is possible providing a skilled staff of impartial inspectors are available to enforce the standards and with sufficient courage to grade down packs where growers have attempted to get inferior fruits through. At one place—Parkdale—in the Upper Valley, the Association has found it necessary to erect a medium-sized packing house fitted with two grading machines—the one a Cutler Grader large machine and the other an Ideal. The former make of machine sized irregularly shaped apples more accurately, and the packers stated they preferred to pack from the Cutler. On the other hand the Ideal was very much less noisy and was said to cause less damage to pears, for the grading of which it was installed.

Growers sending their apples to the Parkdale House for packing and warehousing have to pay the actual cost of packing, which can only be finally determined at the end of the season. For 1923, when 49,952 boxes were handled, the charges made were:—labour 5½d., materials 11½d., overhead charges 3d., or 1s. 8d. per box in all. For cold storage and selling an additional charge is made.

Cold Storage.—The bulk of the apples are Newtown Pippins, which is a late variety if properly stored. The Association soon realised the assistance that cold storage could give, and accordingly have erected near the railway station in Hood River Town, a gigantic cold storage building in which half a million boxes can be stored with ease. The cost of the building and equipment, $500,000, was secured on notes from the growers and loans from the bank, whilst the annual maintenance charges are met by charging a fee on each box placed in storage.

The water power of the Hood River generates electricity to work the ammonia compressor of the cold storage plant, to carry out the lighting of the whole building, and to drive the

mechanical elevators with which the building is abundantly equipped.

The early attempts at cold storage were not entirely successful, due generally to the decay of some blemished fruits which had passed the sorters and packers, but with experience and greater skill these have been eliminated—and with the development of the oil wrap instead of tissue paper wraps few difficulties now arise. The chambers have to be well ventilated by forced circulation of air, and kept at a steady even temperature of 32 to 33° F. with a suitable air humidity and the apples keep fresh and bright right until February, March and even later.

Cold storage has given great hopes to the pear industry, and made it possible to market even soft varieties in good condition in distant markets. Bartletts (William Bon Chrêtien) and Beurré D'Anjou are largely grown, and without cold storage, total losses of Bartletts often resulted. Now the Bartletts are picked just before they are ripe, hurried into storage with the least possible delay, and kept at 32° F. or even 31° F. until thoroughly cooled right to the centre. These cold pears can be shipped in refrigerated cars to distant markets, or kept in storage for a month or six weeks until the canners are ready to deal with them.

Cold storage has more or less solved the marketing difficulties of soft ripe pears, and has given the Hood River growers such confidence that new acreages are being planted. The pre-cooling of soft fruit such as peaches, strawberries and cherries before shipment by rail has permitted the fruits to reach distant markets in better condition.

The Association has displaced to a large extent the independent merchants in the producing areas, and now trades in much the same way as any merchant would do. Consignments are dispatched to the market in a manner deemed to be intelligent according to the best available information, but no doubt here and there markets occasionally are fed too rapidly and gluts occur. By handling such a large proportion of the output of the district, some attempt at orderly marketing can be made, especially so when cold storage accommodation is available for nearly two-thirds of the whole output.

In many other ways the Association helps. It gives great service to its members in purchasing artificial manures, sprays, boxes to the extent of fully $900,000 (£180,000), and is able to form a clear estimate of the year's crop and acquaint the railway companies in advance as to the car requirements.

INTRODUCTION OF A PARASITE OF THE WOOLLY APHIS.

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IN 1922 it was decided to explore the possibilities in this country of the Chalcid " wasp " *Aphelinus mali* as a controlling agent for Woolly Aphis or American Blight (*Eriosoma lanigera*). The insect had already at that time received considerable attention in other countries, both in Europe and elsewhere, and its introduction had been attended by a considerable measure of success in the countries adopting it—a success which, as far as reports are available, has continued up to the present time, being most notable in the case of New Zealand, where Dr. Tillyard has elaborated a well-equipped organisation for breeding and distributing the insect.

Notwithstanding the excellent reports of *Aphelinus mali* from elsewhere, it was considered needful to keep an open mind and view with some reserve the possible outcome of an attempt to establish here this insect of American origin. There appeared to be no country in the list of those adopting it where the climate was likely to provide quite so many difficulties, and the question of sufficient hardiness to withstand an English winter was especially in doubt.

Material for the introduction of *A. mali* into this country was received in March, 1923, from France, by the courtesy of Dr. Paul Marchal, of Paris, in the form of dried bodies of aphides containing full-fed larvæ of the parasite. The adults emerging from this original material multiplied at a prodigious rate in captivity on apple trees in pots infested with Woolly Aphis during the following summer, and by 1924 it was possible to consider introductions in the open at various chosen centres.

It will be seen from the following reports that not only were the weather conditions of the past year extremely adverse to the parasite, but coincident with this disability, Woolly Aphis, its host, was in most places abnormally scarce—in some areas even completely absent. In many instances the first few colonies showing tiny clumps of wool, the usual precursers of the infestation to come, completely failed to develop further and as far as this pest is concerned the trees remained clean throughout the season. This condition of affairs was well illustrated at Harpenden, where, apart from parasites bred in confinement for distribution, an introduction was made in the open in an orchard usually heavily infested with Woolly Aphis. Late in the summer

no trace of Woolly Aphis or parasites was discoverable, and it can only be inferred that the parasites perished from lack of material to work upon.

Like most of the Hymenoptera, *Aphelinus mali* is a sun-loving insect, flying readily on warm, still days. The cold, wet and windy weather prevailing during so large a portion of 1924 would militate considerably against its spread in districts where its host occurred in sufficient numbers to enable it to make headway. So much do dull and windy conditions affect the insect that at the laboratory it has been found that in such weather trees in pots upon which are many winged adults can be moved across the open without danger of losing any, the higher the wind the safer being the operation.

Notwithstanding adverse conditions, the results of last season's introductions of *Aphelinus mali* are distinctly hopeful. In Somerset, Devon, Norfolk, and the Isle of Ely, the insect increased and has probably established itself: in some other districts it has not, at least, died out.

The behaviour of the insect during the winters of 1923-4 and 1924-5 has dispelled any doubts that might at first have been entertained as to its ability to endure the English climate. Indeed, it is hardier than might be suspected. In the winter of 1923-4 some late emerged adults in an open gauze-covered cage continued to live without harm while the thermometer was registering 19°F. of frost outside. This is much more than many of the indigenous Hymenoptera (*Ichneumons, etc.*) could endure as adults, so little fear need be felt for the larvæ and pupæ of the Chalcid.

It is probable that *A. mali* failed to exhibit some of its main characteristics during the inclement season of 1924. There is a continuous overlapping of broods, but it is also observable that there are very large emergences at intervals during the summer, when the insects appear in a kind of swarm. Should the day then be still and sunny they fly away in different directions. No such spread occurs in dull weather. There would be few hot days in 1924 to coincide with maximum emergences, and it is therefore likely that the spread of the parasite was very much less than would normally be the case.

Life History.—Perhaps the substance of the reports may be made more clear to those who have not seen previous references to the insect if a few words as to its life-history are given.

The female fly or wasp (the latter designation being nearer to the truth, as *A. mali* is allied to the true wasps whereas it has little relation to the true flies) places her eggs inside the bodies of

Woolly Aphides by means of a specialised piercing organ, the ovipositor. On hatching, the egg produces a legless, flaccid grub which continues to grow by feeding on the internal juices and organs of its host, the Woolly Aphis. By the time the grub is full-fed, the whole of the interior of the aphis is consumed, only the outer shell being left. Unlike many insects, the parasitic grub does not spin a silken cocoon within which to undergo the pupal condition previous to emerging as an adult fly, but continues to lie within the empty skin of the aphis, the latter becoming tough and dry and serving the purpose of a cocoon. Indeed, it has become convenient, though strictly incorrect, to speak of these dried aphis bodies containing larvæ or pupæ of *A. mali* as cocoons.

Shortly after being parasitised, a Woolly Aphis loses its familiar woolly covering—in reality a wax-like secretion—and when containing a full-fed grub or pupa, is quite black, so that it is always readily possible to distinguish the work of the parasite and estimate amongst colonies of Woolly Aphis the extent of parasitisation. When the pupa has become an adult Chalcid within the aphis, and after its integument has become hardened and the " wasp " ready to merge into the open, it bites a way out, so that empty skins can be easily recognised by the hole they contain. Therefore a black and dry-looking Woolly Aphis, if intact, may be presumed almost with certainty to contain a larva or pupa of the parasite.

Several generations of *Aphelinus mali* appear during the year, and there is considerable overlapping. The winter is passed as a larva or grub within the aforementioned dried aphis skin attached to a twig or bough, the pupal condition being attained in the spring shortly before emergence. By cutting off twigs with cocoons attached and fixing them close to colonies of Woolly Aphis in the spring, an easy way of distributing the parasite is found. In this way or as adults later in the season the parasite was distributed to the following centres :—

Seale Hayne, N. Devon ...	cocoons April 30th
Evesham district	cocoons May 6th
Cambridge	cocoons May 12th
Hereford	cocoons May 15th
Kent	cocoons May 17th
East Malling, Kent	adults June 25th
Newport, Salop	adults June 27th
Chichester	adults June 27th
Wisley, Surrey	adults June 30th
Reading district	adults July 4th
Norwich district	adults July 5th
Bangor district	adults July 14th
Long Ashton (Bristol) district	adults July 26th

Comments and Reports on the Distribution.—Mr. Costin, Horticultural Superintendent at *Chichester*, writes, 23rd March, 1925 :—" The small blackened bodies . . . are fairly numerous in the orchard." Cocoons are referred to—the insect seems therefore to have established itself and left a stock for the current year.

Mr. Kent, Horticultural Superintendent, who by arrangement with Mr. Petherbridge introduced the insect into the *Isle of Ely*, reports :—" The colony of *Aphelinus mali* supplied by the Ministry was introduced on 9th May into an orchard near Upwell. Although the remainder of the orchard was sprayed with a carbolineum wash, four trees of Allington Pippin apple, very badly infested with Woolly Aphis, were reserved unsprayed, and remained unsprayed throughout the season. The colony was attached to one of the four trees, and in a few weeks it was noticed that numbers of Woolly Aphides on two of these trees were without their normal wool-like waxy covering, development of the Chalcid larvæ in their bodies apparently preventing the excretion of the wax. By the end of June dead blackened bodies of Woolly Aphides were readily noticeable on two of the four trees, each blackened body showing the small round hole from which the adult Chalcid had emerged. In July dead parasitised Woolly Aphides were observable on all four trees, and small branches from two of the four were placed amongst the branches of trees in other parts of the orchard. In September a few Chalcids had emerged in two other parts of the orchard. In September also it could be seen that one of the four unsprayed trees was almost completely cleared of Woolly Aphis, while the numbers of the pest on the other three trees were very greatly reduced. In the first week of that month I attempted to introduce the Chalcid into orchards at March (2), Wisbech St. Mary, Leverington, and Haddenham, by placing branches from the four trees at Upwell into trees in these places. No Chalcids have emerged from the trees yet in the case of any of these secondary introductions, but I hope that some may be overwintering in aphid bodies on these trees."

" There appears to be sufficient material at Upwell to carry through the winter and give rise to egg-laying Chalcids in the spring, as Woolly Aphides minus the usual wool are fairly plentiful on two of the four trees. The four trees are to remain unsprayed again in 1925, but the remainder of the orchard has again been sprayed with a carbolineum wash."

" The weather in 1924 was, except for a fine, warm period in July, wet and cool, being generally against the development of

the Chalcid. In spite of this the colony has succeeded in establishing itself so far, and should the winter not prove fatal, I anticipate its spread next season somewhat more extensively."

Mr. Massee, East Malling Research Station, *Kent*, states :—" There is only one place in which the parasite can be said to have definitely become established."

Mr. Staniland, *Long Ashton, near Bristol*, reports :—" The colony on arrival was found to contain five living individuals only. These were placed on trees infected with Woolly Aphis in a greenhouse pending the completion of our insectary. Later a few *Aphelinus* appeared and we managed to work up a good stock, consisting of half a dozen small trees well covered. Woolly Aphis has been scarce at Long Ashton until the end of August and beginning of September, when *Aphelinus* was placed out in three places on the plantation. All the pot trees of stocks, except two, have also been placed out in the plantation."

" *Aphelinus* has spread on the trees on which it was actually placed, but I have been unable to detect any spread on to other trees. This would be accounted for by the very small number of days which have not been windy, Long Ashton being a particularly windy place. At the present time there is a fair number of parasitised aphides without emergence holes, and therefore presumably containing hibernating *Aphelinus* larvæ."

" *Aphelinus* has been placed in an orchard at Wiveliscombe, near Taunton, Somerset, and here also there are apparently sufficient hibernating individuals to carry on next season. A small stock was put out at Cannington but has not succeeded in getting a hold."

Mr. Mosley of *Reading* reported that conditions in his district were most unfavourable and that a few isolated cocoons only exhibited the presence of the parasite on 12th February, 1925.

Mr. Goude, Horticultural Superintendent for *Norfolk*, reports :—" The flies were released on the day of receipt, on a tree badly infested with American Blight in a plantation at Dereham. They increased during the summer plentifully, and the reduction in the amount of blight on the tree, and adjoining trees, was noticeable towards the end of the summer. Patches of the blight now appear black in the infested area, and I believe that these black areas are carrying plentiful cocoons of the Chalcid."

Mr. Hodson, Seale Hayne College, *Devon*, reports :—" The site selected for the release of the parasite was a mixed orchard on the Cornish bank of the River Tamar. This orchard lies

within a few feet of the river level in close promixity to other orchards, and has ample evidence of long-standing attack by Woolly Aphis."

"A rather unfortunate factor from the point of view of the complete success of the introduction is the fact that Woolly Aphis has been singularly scarce in the West Country during the past season, this scarcity being attributable to the particularly cold and wet weather experienced during the spring and early summer."

"A number of twigs covered with parasitised aphides were received from Harpenden early in May. The parasites commenced emerging on 10th May, and these were released in the orchard on the 12th. The twigs—which still retained the majority of the parasites—were fastened in two bunches on adjacent trees. These were protected from heavy rains by wire cylinders covered in butter muslin, which were, however, left open at the ends in order not to interfere with the egress of the parasites on emergence."

"The introduction was followed immediately by a week of heavy rain, and on a second visit being paid to the orchard on 22nd May, it was found that emergence was complete, but careful search on and near patches of aphides failed to disclose a single parasite. The orchard was again visited in June and July with similar results. On 21st August, however, several large clusters of parasitised aphides were observed, and numbers of *A. mali* could be found on the wing and resting on patches of aphides. Further adults were released on this occasion."

"A visit was not again paid until 8th October, when adults were again found with ease, and considerable numbers of parasitised aphides were to be observed on trees at some distance from the points of introduction. It remains yet to be seen how the parasite will stand the winter, but given favourable weather it should undoubtedly make good progress in the spring."

"It is hoped that it will be possible to utilise this orchard as a distribution centre for Devon and Cornwall next season, and it is further hoped that a stock will be available in an orchard on Seale Hayne College farm for a more comprehensive study of the parasite's behaviour under field conditions in this country."

Mr. Jary, Harper Adams Agricultural College, Newport, *Shropshire*, reports:—"The adult Chalcids were received on 27th June, most of the insects in the tube having suffered no harm in transit. A few, however, were dead or damaged. The living specimens were liberated in the evening, immediately on

arrival, the tube containing them being supported from a branch immediately alongside a large colony of Woolly Aphis. Tho tree was a large standard Bramley's seedling."

"Woolly Aphis, which was somewhat late in appearing in numbers in 1924, was then becoming well established in situations occupied the previous year, large galled growths having been formed. The weather had been warm during the previous week but on 27th became much cooler and slight rain fell throughout the afternoon of 28th. Thunderstorms and very heavy rain followed on 2nd and 3rd July."

"Throughout the summer the Chalcid appeared to be established, but making very little headway. Colonies of Woolly Aphis at present on the tree show only a few parasitised members. A small number of larvæ are present and several empty skins of aphides showing exist holes."

"On the whole, I think, in an unfavourable summer, with the amount of Woolly Aphis considerably below the average, the parasite has done little more than maintain itself."

Mr. Goaman, *Hereford*, reports on 29th July, 1924 :—" Fresh emergences from cocoons on the trees at Purley on the 7th July and 18th July respectively. The whole of the original tree is free from Woolly Aphis and the *Aphelinus* has spread to other trees up to 30 feet." On 31st October, 1924, he writes :— "There appeared to be a few overwintering cocoons. In this plantation the Woolly Aphis appeared to migrate at the end of the summer but it is now appearing again. Whether the migration adversely affected the spread of the *Aphelinus*, I cannot say for certain, but I think so."

Mr. Maltby, *Evesham*, reports that conditions in this area were unfavourable, Woolly Aphis failing to develop further when the parasite was introduced.

Mr. Petherbridge, *Cambridge*, also reports :—" The parasite does not appear to have established itself at this centre."

At *Bangor* results were not promising and overwintering cocoons have not been discovered, while at *Wisley* and *Rochester* Woolly Aphis failed to develop.

INVESTIGATIONS OF SPRING-TAILS ATTACKING MANGOLDS.

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AN attack on mangolds known as "Black Leg" or "Strangle" has been reported from several districts during recent years. Considerable damage has been noted in North Wales, Shropshire, Lancashire, and other areas during 1922-1924. As the name suggests, the characteristic feature of the attack is that of a pinching off or strangling, which often results in the upper portion of the mangold being severed from the root. Bleeding takes place during the attack and causes a blackening at the severed point, thus giving rise to the term Black Leg. (It should be noted that the severing occurs at or slightly above soil level, and not below as in the case of attack by the larvæ of the beetle *Atomaria linearis.*)

This disease has been attributed to several causes, including the attack of wireworm, larvæ of *Atomaria linearis*, *Collembola* (Spring-tails), fungi and bacteria. In this *Journal* for December, 1922, p. 828, it was suggested that spring-tails might be the cause.*

The amount of damage done is variable, but that it can be serious has been shown this year near Bangor, where 25-30 per cent. of the crop was destroyed. Destroyed roots were received at the Laboratory of Agricultural Zoology, University College of North Wales, from Mr. W. J. Gough, manager of the Penrhyn Home Farm, and investigations as to the cause of attack were immediately commenced.

The field in which the attack took place is situated about 200 feet above sea level, having a considerable slope with north-west aspect. The soil is of a heavy nature, and recent continuous rain had resulted in a wet surface. Three acres of the field contained mangolds which had followed oats in rotation, roots having been last grown eight years previously. The varieties, Yellow Globe and Golden Tankard, had been sown on 23rd and 26th May, 1924, respectively, and the crop had been singled and scuffled so that the field was clean. Damage was first noticed by Mr. Gough on 1st July, after which dressings of nitrate of soda were given and the destroyed plants collected and burnt.

* R. Stenton, Pathological Laboratory, Ministry of Agriculture.

Observations on 26th July (by which time the destruction of plants had almost ceased) revealed the fact that the attack was confined in the main to the variety, Yellow Globe, and chiefly to the lower and damper portions of the field. Results of three successive counts of 100 each gave 27, 43 and 35 destroyed plants respectively—an average of 35 per cent.

The usual method of cultivation had been applied to the 1924 crop, thus eliminating the possibility of the trouble being due to any abnormal farm operation. Spring-tails were found in abundance, the following species being obtained: (1) *Bourletiella hortensis*, Fitch (*pruinosus* Tib.); (2) *Isotoma viridus*, Bourlet; (3) *Isotomerus palustris*, Müller; (4) *Sminthurus viridis*, Linn.; (5) *Bourletiella lutea*, Lubbock; (6) *Dicyrtominia minuta*, Fab.

Of these, (1) to (4) were abundant, but (5) and (6) were less frequent. The black globular species (*B. hortensis*) was found on every leaf examined, while numbers were present on the roots of mangolds, soil, stones, etc. Both species of *Isotoma* and *Isotomerus* (elongate, slate-coloured, and brown spring-tails) were confined to the roots and the soil. The yellow globular forms (*S. viridis* and *B. lutea*) were present on both roots and leaves. Mangolds were secured and photographed at the various stages of attack as shown in Fig. 1, and in each case spring-tails of the first four species mentioned were found at the point of infection. Three successive counts at individual attacked plants resulted as follows:—

(1) 7 *Isotoma viridis and Isotomerus palustris*, 11 *Bourletiella hortensis*, Fitch, 9 *Sminthurus viridis*; some others escaped.

(2) 21 *Bourletiella hortensis* (observed around the circumference of the root at soil level), 8 *Sminthurus viridis*, 6 *Isotoma viridis* and *Isotomerus palustris*.

(3) 15 spring-tails (various).

Rain fell almost continuously during 27th and 28th July (totalling 1·49 in.), and the observations were made on the latter date during heavy showers. The globular species of *Bourletiella* and *Sminthurus* kept to the under surface of the leaves, while both species of *Isotoma* and *Isotomerus* were very active on the surface of the soil and as many as 12 were counted near a non-affected mangold.

In one instance a singe *Isotoma viridis* was observed feeding on a young mangold of 6 mm. diameter. This spring-tail was observed under a hand lens enlarging for nearly ten minutes (after which the wind blew it off) a hole which finally measured

4 × 4 mm. (Fig. 2 depicts a section through this bitten area). The method of feeding was that of a rasping or gnawing action penetrating deepest at the centre. A similar freshly-cut cavity also appeared immediately above the spring-tail and this measured 6 × 2 mm.

The crop showed a considerable amount of leaf attack, and it was observed that spring-tails of all species were at work feeding on the leaves, resulting in considerable holing. In one instance such a hole measuring 2 mm. was made in a leaf by three *B. hortensis* in about five minutes.

Eradication.—On 29th July control experiments were commenced on the chess-board system, the insecticides used being: (1) A 5 per cent. nicotine sulphate dust (40 per cent. black leaf) equivalent to 2 per cent. pure nicotine, (2) fine air-slaked lime, (3) pyrethrum powder, and (4) a 1 per cent. green tar oil dust. All were distributed by means of a small hand sulphurator.

Further heavy rains fell during the few days following these applications, and observations were made as given below.

(*a*) *Nicotine Sulphate.*—This proved an excellent contact insecticide for the *Isotoma* and *Isotomerus* species, giving 100 per cent. kill, and was used by the writer as a means of collecting them, the insects being gathered with the forceps after dusting. *S. viridis* was also killed, but *B hortensis* skipped away to parts where the dust had not reached. Under such conditions as prevailed on 29th and 31st July (total rainfall of 0·65 in.) the effect of this insecticide was not lasting, for by 1st August the numbers of spring-tails had again reached those of the control plots.

(*b*) *Lime (fine air-slaked)*—This also was a useful contact insecticide, though not so effective as nicotine sulphate. On 29th July when the plot was evenly dusted with lime the spring-tails skipped about quickly, some being killed, but by 1st August the *Collembola* were observed creeping over the limed surface.

(*c*) *Pyrethrum Powder.*—This was not seen to kill any of the spring-tails, its action being rather that of a repellant. The numbers were lowest on 2nd August, four days after treatment.

(*d*) 1 *per cent. Green Tar Oil Dust.*—An active repellant. Spring-tails of all species moved rapidly away from plants and soil thus dusted. The numbers were lowest on 30th July, after which there was an increase until they attained those of the control on 4th August.

Rapid growth of the mangold crop during this period then minimised the effects of attack, and the field experiments were discontinued. The diameter of the mangolds at this stage was

about 2-3 cm. A final examination was made on 6th August, and showed that *B. hortensis* had practically disappeared, while the numbers of all the other species had considerably decreased. The rainfall for 4th-6th August inclusive averaged 0·45 in. The heavy rainfall throughout the observations undoubtedly affected the results of the experiments.

Observations in the Laboratory.—It was suggested in this *Journal* for December, 1922, that a yellow variety was more susceptible to attack on account of the greater proportion of root visible above soil level as compared with a red variety. With this point in mind the two varieties were examined in the field, but no appreciable difference was noticed during these investigations. The susceptibility of Yellow Globe was so marked that in rows containing both varieties, Yellow Globe plants were destroyed while adjacent plants of Golden Tankard were untouched. Both varieties examined were apparently identical in size, growth, and position of root above soil level.

Variability in thickness of the outer epidermis was next considered as a possible cause for this difference in susceptibility, but microscopical examination revealed no appreciable difference.

The concentration of cell sap was a possible factor, since spring-tails were observed feeding on the cell sap oozing from attacked Yellow Globes. Golden Tankards were then cut and left in position in the rows to allow bleeding to take place, and when observed on the following day numerous spring-tails were seen feeding on the cell sap which had oozed out, showing that no differentiation was made between the actual sap of each variety.

Microscopical examination of cross-sections of both varieties revealed the fact that the amount of orange-coloured stain (carotin) present in the outer epidermal cells of the root of Golden Tankard was much greater than in the case of Yellow Globe, and, further, the colour was deeper, suggesting a higher concentration and the presence of an anthrocyanin. Some nauseous effect of the stain is possibly a factor of considerable importance in the greater immunity of Golden Tankard.

Spring-tail Attack under Laboratory Conditions.—Mangolds were transplanted from the field into a cage in the laboratory, and considerable numbers of spring-tails were introduced; the numbers were reinforced daily, but difficulty was experienced in securing sufficiently rapid root absorption in the loose soil of

the cage, and also in securing the slight leaf transpiration essential for bleeding in such a comparatively dry atmosphere. These plants were examined daily, and the movements of the spring-tails observed. Leaf damage was seen to take place and individuals of *Sminthurus*, *Bourletiella*, *Isotomerus* and *Isotoma* species were all observed to cause perforation of the leaves. Root attack took place (although not personally witnessed) and on examination a week later one of the mangolds had developed a root constriction similar to those noted in the field, and microscopical examination revealed similar bite marks. The experiment was allowed to proceed until 3rd October, when the plants were removed for final examination. Under these largely unnatural conditions growth had taken place mainly in the leaves, all of which showed marked holing. The roots were scarred with markings comparable to the cavity produced by the individual of *Isotoma viridis* on 28th July mentioned on p. 351.

Botanical Examination of Constricted Mangolds.—It was observed that in numerous mangolds collected in the field a constriction occurred at the point of attack (see Fig. 1), and as growth proceeded this constriction became more and more marked. The botanical structure of the mangold is such that growth takes place in a series of concentric cambium rings, thus differing from the general farm root crops. The cambium cells are richest in sugar content and thus more attractive to the insect feeders. Specimens of mangolds which showed this constriction were secured and transverse sections through the constricted areas were examined microscopically. Preserved sections show clearly that the initial bites remove small portions of one of the first formed rings of cambium, and that each successive ring fails to complete its circumference at these points of attack (see Fig. 3). The result of this is that there is formed a crevice or constriction which becomes larger as each successive concentric ring is added, and the final result is fracture and death of the plant. All types of constriction may be noted in a field suffering from attack, differing with the position of the initial damage due to insect (or other) injury.

The work was carried out at the suggestion of Dr. C. L. Walton, Adviser in Agricultural Zoology for North Wales, whose valuable assistance is gratefully acknowledged. The writer is also indebted to Dr. G. H. Carpenter for identification of the *Collembola* (spring-tails) collected, and to Mr. W. J. Gough for information and help in connection with field experiments.

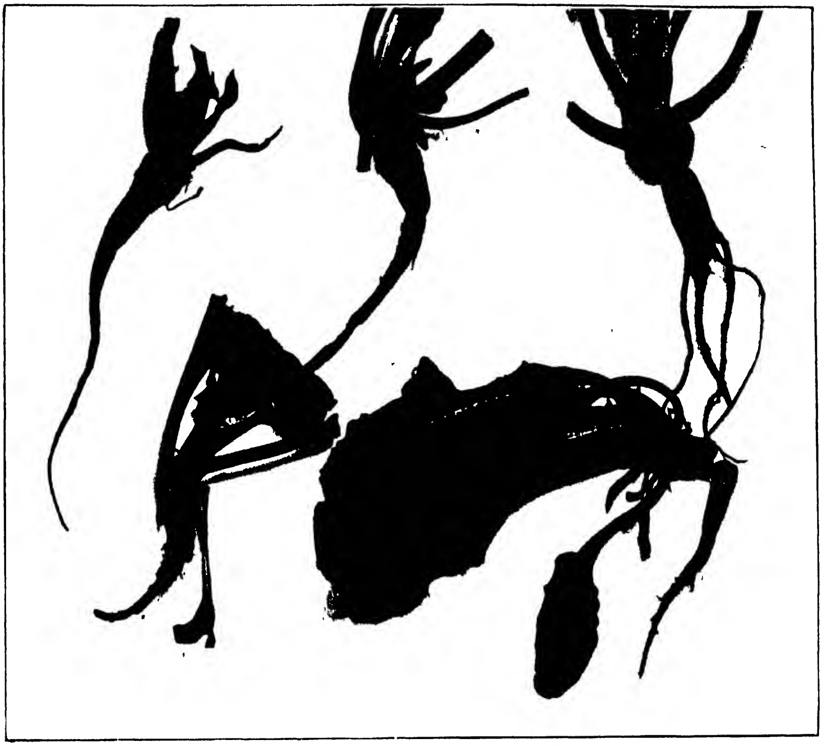

FIG. 1.—Mangolds attacked by Spring-tails, showing the constriction at the point of attack.

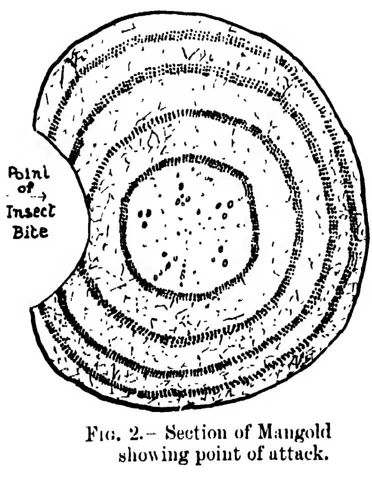

FIG. 2.—Section of Mangold showing point of attack.

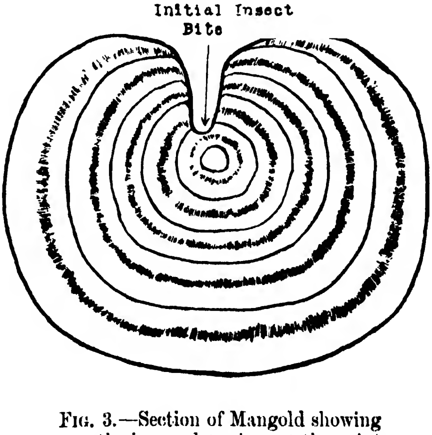

FIG. 3.—Section of Mangold showing the incomplete rings at the point of attack.

LOGANBERRY CULTIVATION.

THE loganberry may best be described as a cultivated form of the American blackberry, *Rubus vitifolius*. It was first introduced into Great Britain about the year 1900, but in the United States it was known to cultivators for nearly 20 years previous to that date, having originated in the garden of Judge Logan, of Santa Cruz, California, in 1881. Once considered to be a cross between the Californian blackberry and the raspberry it is now thought to be a variety only of the former species. Botanically the plant has no fundamental difference from *R. vitifolius*, but the fruit is redder, larger and more juicy, and ripens much earlier. Also, it is very much more prolific.

The loganberry speedily became a popular fruit, its chief value lying in its very marked piquancy of flavour, which serves to enhance the quality of jams made from other soft fruits when mixed with them. Loganberries are also a valuable fruit for bottling and canning, for jelly making, and for mixing with other fruits for tarts, etc. The concentrated juice of the fruit is considered to be superior to any other, and finds a ready sale in bottles. In America a considerable quantity of this juice is produced every year, and is readily disposed of to the manufacturers of beverages, etc.

The fruit of the loganberry is large and tapering, and usually an inch or more in length. It closely resembles a mulberry in appearance. The colour when fully ripe is a dark purplish red, but when picked for market the fruit is nearer the colour of the raspberry. It is very juicy and the flavour is sharply acid and refreshing, being quite distinct from that of any other fruit.

The plant in habit is trailing, with a perennial root-stock from which new canes are thrown up each year to bear fruit the following year.

The loganberry is not grown commercially in Great Britain to any large extent, but the area under cultivation could very safely be extended. The principal centres of production are Kent, Middlesex, Worcester and Hereford, but the total area probably does not exceed 300 acres. In Kent the fruit is found to thrive well in old hop gardens, particularly on the strong, heavy loam of the Weald.

Soil and Situation.—Largely on account of its robust habit the loganberry thrives well on most average soils where there is good depth. It is not so particular as regards soil conditions as the raspberry, and provided good dressings of organic manure can be given it will do well where raspberries fail. It grows well

on the strong heavy loams of the clay, and good plantations are often found on the lighter soils overlaying chalk. Wet, badly drained soils are unsuitable. An important point is to ensure that the canes are thoroughly ripened after each season's growth, and on account of this, districts where wet autumn months prevail are not suitable. Unless the canes are properly ripened the yield of fruit will not be encouraging, and, moreover, hard winters will bring about damage by causing them to die back or die out completely. The crop needs as much sun as it can get.

Propagation.—Unlike the raspberry, the loganberry does not throw up suckers remote from the parent stool, which may be dug up and used for planting fresh ground. New shoots are produced from buds formed on the rootstock only, from which they cannot readily be separated. These shoots will, however, when fully grown, root naturally at the tips and so form a new plant. These tip plants may be produced in an established plantation by covering the tips of fully grown canes with an inch or two of light soil in the autumn. By early spring roots will have formed together with a basal bud, and the plant may then be severed and removed. Nurserymen usually grow on these tip-plants for another year and distribute them as maiden canes.

Another way of obtaining a rapid increase of stock is by root cuttings. Pieces of roots about 4 inches long are employed and should be planted up in the autumn in sandy soil. Also ripe canes may be cut into cuttings and struck in sandy soil in frames.

Seeing that tip-plants can be obtained from an established plantation without harming the canes, growers might well bear this in mind and thus obtain an additional income from the sale of the plants to nurserymen and others.

Preparation of Land.—Unless the land is in good heart, as in the case of old hop gardens, it must be thoroughly prepared by ploughing and cross ploughing, preferably in the autumn. A dressing of farmyard manure, 20-30 tons to the acre, should be applied before the final ploughing. The practice usually followed in preparing land for fruit should be closely observed. Lime or chalk may be necessary, and this is best applied to the land just before planting.

Training and Planting.—A most important question to be decided is the method of training the plants. The trailing growths must be adequately supported if good results are to be obtained. A diversity of systems prevails, but amongst commercial growers

two distinct methods are adopted and appear to answer satisfactorily. From many points of view the staking system, mostly employed with success in Kent, is to be recommended. The plants are set out on the square at 4 ft. to 6 ft. apart in the rows according to the strength of the land, the rows being 6 ft. apart. Each hill is provided with one or two good stout poles about 8 ft. in height above ground, and 2 ft. below ground level. These poles are wired overhead with strong galvanised wire to obtain rigidity. If one pole only is used to each hill the fruiting canes are tied to it with tar twine and the runners, as they grow, are directed along the base of the rows, being tied up in place of the fruiting canes directly these have finished bearing and have been cut away. If two poles are used the fruiting canes are tied to one and the runners to the other alternately. Not more than six canes are allowed to each pole, all others being cut away before they attain any length.

The second system consists of training the growths on an upright wire trellis. This trellis is constructed of stout, durable 7 ft. posts, placed at intervals of from 15 to 20 ft. The posts should go in the ground 2 ft., thus leaving 5 ft. above ground. Lighter strengtheners may be driven in between these, and the end posts should be exceptionally stout and be provided with strainers. Upon this framework stout No. 8 galvanised wire is stretched taut, three, or at the most four, strands being sufficient. The plants are put out against this trellis, at from 8 ft. to 12 ft. apart, and the growths are tied fanwise to the wires. The trellises should be 6 ft. apart. The system answers very well for loganberries, but has one drawback. Owing to the profuse growth of new canes the fruiting canes are apt to become smothered and the yield is affected. It is difficult to see and gather the fruit. Also it is not possible to cultivate the ground both ways as in the case of the stake system. Taking both training systems on their merits, staking is considered to be the better plan, and to give the best results. This system has been largely employed in old hop gardens, the existing poles and wire coming in very usefully for the general scheme. Good leather gloves are necessary for the hands when handling the canes owing to their exceptionally spiny nature. When tying up to poles two workers should operate together, one holding up the canes and the other tying.

Planting is usually done when stock is available, either in the autumn or spring. Tips of canes covered with soil in the autumn will have formed roots and basal buds by the following

April, when they may be severed from the parent cane and carefully planted up in their permanent places, or they may be grown on for a year in nursery beds. If stock can be obtained for autumn planting so much the better. Holes for the plants are opened with a spade, and if a forkful or so of good rotted manure can be given to each hole it will be advantageous.

Pruning.—As explained above the fruit is borne on canes produced the previous season, and therefore it is all to the good if these canes are removed directly they have finished fruiting. There is no advantage whatever in delaying their removal, and it helps the next season's cane considerably if performed early. Also, the grower should recognise that there is no advantage in allowing more canes to grow than are needed. Five or six at the most in the case of stakes and from eight to twelve to a hill on the trellises are considered to be ample. Healthy shoots may attain a length of 15 feet, but it pays to stop them when a convenient length is reached. If lateral shoots are produced it is advisable to spur them back before growth commences in the spring.

After-care of the Plantation.—During the first year or so the land between the rows may be usefully employed for crops of vegetables, etc. Loganberries are shallow, fibrous rooting plants; therefore the land between the rows should be only lightly ploughed or scarified each winter. During the summer horse-hoes set as high as possible should be used to keep down weeds and secure a surface tilth to maintain the soil moisture. The land should receive a dressing of from 10 to 15 tons of dung to the acre each winter to insure good results. In dry seasons the plants can be considerably assisted by employing a mulch such as long stable manure, grass and other green matter.

Gathering and Marketing the Fruit.—Loganberries, unlike raspberries, retain the plug when gathered. If required for dessert purposes, the berries are picked with the "strig" or stalk attached. For ordinary market purposes the fruit should not be dead ripe or it will tend to bruise in picking, and will not travel or keep well. The colour should be a good deep red. For dessert the fruit can be left until it is a rich purplish red, providing rapid and careful transit is available. Loganberries travel and preserve their appearance much better than raspberries, although rather more liable to attacks of mildew in wet weather.

The plants should be picked over every second or third day while the fruiting period lasts. On no account should the fruit

be picked when the plants are wet with rain. In gathering it is best to have both hands free, and this may be arranged by employing trays suspended by a strap round the neck to hold the fruit. The pickers should be instructed to be reasonably careful in handling the fruit, and the use of three fingers instead of two has been found the safest way to avoid bruising. The grower should know beforehand for what purpose his fruit is destined as it is obvious that greater care is necessary with fruit for bottling.

Loganberries commence to ripen early in the summer, normally about the last week in June, and continue with good fortune until the end of July or second week of August.

The fruit is usually dispatched to market in 4 lb. chip baskets, a certain amount, usually dessert fruit of good quality, being packed in 1 lb. punnets in trays holding 12 lb. or 20 lb. Preserving fruit is dispatched either in pecks holding 14 lb. or in tubs, as in the case of raspberries, and usually goes direct to the factories.

The Raspberry Beetle.—This insect is by far the most serious pest of the loganberry, which it seems to prefer even to the raspberry. The damage is done by the beetle maggots (larvæ) which feed within the fruit, greatly reducing its value for market. Not only is the fruit itself injured but the presence of many maggots in a sample prevents its use for bottling and renders its sale difficult for other purposes. Unfortunately no satisfactory means of dealing with the pest has yet been discovered. Perhaps the best measure is to run poultry in the plantation since fowls devour the insect freely in all stages. Some growers have found it worth while to tap or jar the canes periodically while in flower, causing the beetles to fall within reach of the fowls. Under experimental conditions, spraying the open bloom with lead arsenate has given promising results, but it is open to objection, firstly on account of the danger of poisoning bees, and secondly because the length of the flowering period would render several sprayings necessary.

When making a new plantation it would obviously be wise to choose a place as far as possible from raspberries and also to clear out of any adjacent hedgerow any wild brambles, which form the insect's natural food plant. The successful cultivation of the fruit depends greatly on the ability of the grower to control this pest.

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JULY ON THE FARM.

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Grass Land.—At this period a year ago, the outlook indicated the likelihood of abundant pasturage; this year the fields are already beginning to look bare, and unless weather conditions change so as to bring on rapid growth, the pastures will require considerable artificial help to support their present head of stock. Unless the farmer has a crop of lucerne or has prepared for emergencies by growing a breadth of tares or other soiling crop, he has to resort to concentrated foods as a means of supplementing short pasturage. The idea of stimulating the pastures themselves has not been extensively tried in this country, but it seems worthy of consideration.

The only stimulant which could be relied upon to produce an immediate effect on grass at this time of the year is a soluble fertiliser of the nitrogenous class, such as nitrate of soda, nitrate of lime or sulphate of ammonia. British exponents of agricultural science do not generally recommend the use of nitrogenous manures on pasture land, when the object is to effect a durable improvement in the sward and especially to increase the growth of the clovers. It must be admitted, however, that little attention has been given to the possibility of increasing the productivity of fairly good pasture by the application of nitrogenous top-dressings. Indeed, little thought has been given to the question of whether the soil supply of nitrates may be short at this time of the year. The Rothamsted records do not indicate great activity in nitrate production in July; they rather suggest that soil bacteria are rather reduced in numbers at this time.

Certain Continental authorities are emphatic as to the value of nitrogenous top-dressings in pasture management, not only as a means of extending the grazing season at both ends, but also to prevent an excess of spring growth being followed by a period of short keep after mid-summer. Professor Falke, of Leipzig, in his "Wiesen und Weiden," strongly advises the application of nitrogenous manures between the end of June and the end of August; and Professor Warmbold, who carried out an extensive series of experiments at Hohenheim, found that the grazing capacity of pastures was greatly increased by the use of nitrogenous fertilisers, part of which he applied in the summer months.

Haymaking.—Ordinarily haymaking is the principal farm operation in the month of July; but this year, owing to the early start made by many farmers, it is possible that much of the area devoted to the hay crop will be cleared before these notes appear. Mowing was general in the Derby district by 15th June and I know of one field actually being stacked by that date. The crops were light and the leas were in many cases remarkably deficient in clover; but the nutritive value of well-made June hay is beginning to be better recognised, and it is not unlikely that the aftermath of the early cut fields will be needed as soon as it is ready to be grazed. Further south haymaking had begun a week earlier.

In some districts there is room for improvement in the matter of attention to the hay after stacking. As the hay sweats and settles, the roof, however skilfully built, tends to become uneven and requires re-dressing before it is thatched; hence it is hardly practicable to thatch a rick immediately it is completed. But in too many cases the stack is allowed to become "piped" and seriously damaged by rain before the protective covering is laid on, not to mention the cases where thatching is entirely omitted. Thatching is expensive and requires skill; sometimes the stacks cannot be dealt with until after corn harvest, when new straw is available. This difficulty is easily overcome by growing a small area of rye, which may be cut in June and the land sown with turnips. The best solution, however, is a Dutch barn. Farmers find that hay may be carted sooner when it is to be put into a barn, as it does not settle so quickly as it does in stacks; but there are so many other advantages connected with the possession of a good hay shed that they are glad to pay a reasonable return on the capital outlay required in its erection, when the owner is willing and able to make this improvement.

Arable Land.—July is a month in which the farmer's thoughts are directed more towards harvesting than sowing. Winter oats, which in the Midlands were in ear by 15th June, will in the ordinary course be ready for cutting before the end of this month, and wheat may be ripe early in August. It is desirable, therefore, that attention be given to the condition of the self-binders, examining the canvasses, tightening up any loose bolts, and rinsing the bearings with paraffin to remove congealed matter which interferes with proper lubrication.

Marrow-stem kale may be transplanted on vacant land during July, thinnings from an earlier sown crop being used

for this purpose. This crop may also be sown broadcast on clean land in the same manner as mustard, excepting that 5 lb. of seed per acre is sufficient where 20 lb. of mustard would be sown. If top dressed with nitrate, it yields a useful quantity of autumn keep, which may be grazed off by cattle without greater risk than is associated with pasturage.

Having regard to the excellent weed-killing weather during the first half of June, there should be little need for deep grubbing between the rows of mangold and turnip crops in July. The inadvisability of deep inter-tillage after the root fibres have spread between the rows was emphasised in these notes last year. Sugar beet, being of much deeper rooting habit than mangolds and swedes, is probably exceptional in this respect; for on the Continent there is a saying that by deep inter-cultivation the sugar is "hoed into the roots."

The abundance of the eggs of the mangold fly on the under surface of the leaves of the plant during the early part of June presaged severe attacks of the leaf maggot later in the summer. Another mangold pest has also been evident from its effects, causing in certain cases the almost entire loss of what was a good plant. The culprit in these was the Pygmy beetle, which is itself almost invisible, but its work is to gnaw away the soft outer tissues of the root, leaving the plant attached to the ground by a thin black string. In two cases to which my attention was specially called, the land was rather low lying and damp and had been cropped with mangolds for several years in succession. Mr. Roebuck, Advisory Entomologist for the Midland province, states that trouble from the Pygmy beetle is often associated with such conditions of cultivation.

Live Stock.—July is generally considered a healthy month for live stock, not being a time when either food or conditions are changed much. Still, there are ailments such as *mammitis* or *garget*, which affects dry cows and which is difficult to control. Apparently the cause is bacteria, which are present in the udder or gain access to it, but which are unable to invade the tissues until the resistance of the organ has been reduced by a blow or a chill. The *warble fly* may be very troublesome, especially in fields where the cattle have not access to shade, and perhaps "gadding" is in many cases responsible for the previously mentioned ailment. Recent work has shown that the warble fly does not lay her eggs on the backs of the cattle as was formerly supposed but on their heels. Hence it is futile to hope for the prevention of warbles by dressing the backs of

the cattle at this time of the year. Probably access to water is a preventive, and it might be thought that walking the animals through a shallow bath of sheep dip might help to keep the fly away from their legs. The horse bot fly, the sheep maggot fly, stomach worms in sheep, the husk worm and the liver fluke are other parasites of special interest to stock owners this month, as this is the time of the year when either they are most troublesome or they gain entrance to the body of the host.

It has often been observed that cattle will drink polluted water, sometimes even in preference to a pure supply, and as the drinking of bad water is not immediately followed by a visible and acute attack of digestive trouble, there has grown up a widespread impression that water impurities do not cause derangements in the health of cattle. Observations by Mr. A. Levie, F.R.C.V.S., Veterinary Instructor for Derbyshire, dealing with twenty herds have, however, produced conclusive evidence that contaminated water, especially water polluted with sewage, is a very potent cause of chronic ill health and loss in cattle. During the summer months, owing to the smaller and slower flow of water in brooks, the degree of pollution is greater; so that where trouble from this source is suspected, cattle should not have access to fields through which a contaminated stream flows.

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MONTHLY NOTES ON FEEDING STUFFS.

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Milk as a Food for Farm Animals.—Since milk is Nature's food for animals, it has been assumed that milk contains all the elements combined in the right proportions necessary for perfect growth of the young. Experiments have shown that this assumption needs modification, particularly when milk designed for one particular species of animal is utilised as food for another species. It has been demonstrated, for instance, that the milk of cows fed under winter stall conditions is often deficient in those vitamines considered essential to growth. Moreover, calves fed on milk to the exclusion of other foods will eventually die. With humans, long breast feeding is also associated with onset of anæmia. Milk is also deficient in one important element, *i.e.*, iron, and the onset of anæmia is probably associated with this deficiency. The reason why the very

young animal grows successfully during the suckling period is that at birth a sufficient store of material rich in iron is present in the liver to supply its requirements during the suckling period. The deleterious effect of the absence of iron in the milk is consequently only shown when this reserve store is exhausted. Analyses of milks of different species show very wide variation among the species, owing to the fact that the composition of the milk of each species is specially adapted for the efficient growth of that species during the normal suckling period. A glance at the table that follows brings out this fact quite clearly:—

Species.	*Water.*	*Protein.*	*Fat.*	*Sugar.*	*Ash.*	Time to double weight (days).
Man	88·5	1·7	3·3	6·0	0·2	180
Horse... ...	90·6	2·1	1·1	5·9	0·4	60
Cow	87·3	3·4	3·7	4·9	0·7	47
Sheep... . .	80·8	6·5	6·9	4·9	0·9	15
Pig	84·1	7·2	4·6	3·1	1·1	10—14
Rabbit ...	79·5	15·50	10·5	2·0	2·5	6

It will be noticed that the milk of different species varies very considerably in percentage composition, both with regard to protein and fat. The sugar and ash also show considerable variation. A very interesting point also reveals itself when the figures are compared with the time taken for each species to double its weight. It will be noted that low ash and protein percentages are associated with the slowest growth rate, and the quickest growth rate is associated with high ash and protein percentages. Moreover, when the ash is analysed it is found that the relative proportions of ash constituents present agree fairly closely with the relative proportions present in the carcase of the young animal, with the exception of iron as already noted above. Since these relative proportions vary with each species it is not easy to substitute the milk of one species with another, since even though the milk be treated so that the relative percentages of protein, fat, sugar and ash are obtained, the balance of ash constituents will be different.

Having demonstrated that milk is not, after all, the perfect food that one has thought, and having demonstrated that the milk of one species may be quite unsuited to another species, a few observations on the desirability of milk as a food may not be out of place. Milk is a food which is highly assimilable by stock, is easily handled, is very digestible, and contains proteins of high quality, *i.e.*, proteins which contain all the elements for tissue building. In the case of very young stock, therefore;

DESCRIPTION.	Price per Qr. s. d.	lb.	Price per Ton. £ s	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv. s.	Price per lb. Starch Equiv. d	Per cent of Digest. Crude Protein %
Wheat, British	—	—	13 5	0 14	12 11	71·6	3/6	1·87	10·2
Barley, British Feeding	—	—	10 10	0 11	9 19	71	2/10	1·52	6·5
„ Canadian :—									
No. 4 Western	38/6	400	10 15	0 11	10 4	71	2/10	1·52	6·5
„ „ Feeding	37,0	„	10 7	0 11	9 16	71	2/9	1·47	6·5
„ American	38/9	„	10 17	0 11	10 6	71	2/11	1·56	6·5
„ Danubian	38/3	„	10 15	0 11	10 4	71	2/10	1·52	6·5
„ Karachi	38/6	„	10 15	0 11	10 4	71	2/10	1·52	6·5
Oats, English, White	—	—	11 3	0 12	10 11	59·5	3/7	1·92	8·0
„ „ Black and Grey	—	—	11 0	0 12	10 18	59·5	2,6	1·87	8·0
„ Canadian :—									
No. 2 Western	32/9	320	11 10	0 12	10 18	59·5	3/8	1·96	8·0
Argentine	28/0	„	9 17	0 12	9 5	59·5	3/1	1·65	8·0
Chilian	29/0	„	10 3	0 12	9 11	59·5	3/4	1·78	8.0
Maize, Argentine	46/9	480	10 18	0 12	10 6	81	2/7	1·38	7·1
„ South African	46/9	„	10 18	0 12	10 6	81	2/7	1·38	7·1
Beans, English Winter	—	—	10 15	1 9	9 6	67	2/9	1·47	20·1
„ Chinese „	—	—	11 10	1 9	10 1	67	3/0	1·61	20·1
Peas, English Maple	—	—	11 7	1 5	10 2	69	2/11	1·56	19·4
„ Japanese	—	—	24 5†	1 5	23 0	69	6,8	3·57	19·4
Rye, Homegrown	—	—	11 10	0 14	10 16	71 6	3/0	1·61	9·6
Dari, Egyptian	—	—	11 0	0 14	10 6	75·2	2/9	1·47	7·7
„ Persian	—	—	11 15	0 14	11 1	75·2	2/11	1·56	7·7
Millers' Offals :—									
Bran, British	—	—	6 12	1 4	5 8	45	2/5	1·29	10·9
„ Broad	—	—	8 15	1 4	7 11	45	3/4	1·78	10·9
Middlings—									
Fine Imported	—	—	9 12	1 0	8 12	72	2/5	1·29	12·6
Coarse, British	—	—	7 15	1 0	6 15	64	2/1	1·12	11·5
Pollards, Imported	—	—	7 7	1 4	6 3	60	2/0	1·07	11·6
Meal, Barley	—	—	12 5	0 11	11 14	71	3,4	1·78	6·5
„ Maize	—	—	11 0	0 12	10 8	81	2/7	1·38	7·1
„ „ South African	—	—	9 17†	0 12	9 5	81	2/3	1·20	7·1
„ „ Germ	—	—	9 10	0 17	8 13	85·3	2/0	1·07	18·4
„ „ Gluten Feed	—	—	9 15	1 5	8 10	75·6	2/3	1·20	20·0
„ Locust Bean	—	—	9 15	0 8	9 7	71·4	2/6	1·34	4·0
„ Bean	—	—	13 0	1 9	11 11	67	3/1	1·65	20·1
„ Fish	—	—	19 10	3 17	15 13	53	5/11	3·17	50·0
Linseed	—	—	22 15	1 8	21 7	119	3/7	1·92	19·4
„ Cake, English 12% Oil	—	—	14 2	1 15	12 7	74	3/4	1·78	25·3
„ „ 10% Oil	—	—	13 7	1 15	11 12	74	3/2	1·70	25·3
„ „ 9% Oil	—	—	13 2	1 15	11 7	74	3/1	1·65	25·3
Soya Bean „ 6 % Oil	—	—	12 2	2 8	9 14	69	2/10	1·52	38·2
Cottonseed Cake, English 5½% Oil	—	—	8 10	1 12	6 18	42	3/3	1·74	17·6
„ „ Egyptian 5½% Oil	—	—	7 15	1 12	6 3	42	2/11	1·56	17·6
Decorticated Cotton Seed Cake 7% Oil	—	—	12 17*	2 9	10 8	71	2/11	1·56	—
„ „ Meal 7% Oil	—	—	11 15	2 9	9 6	74	2/6	1·34	36.3
Ground Nut Cake 7% Oil	—	—	10 5*	1 13	8 12	56·8	3/0	1·61	42·0
Palm Kernel Cake 6% Oil	—	—	8 7†	1 1	7 6	75	1/11	1·03	17·1
„ „ Meal 2% Oil	—	—	8 0	1 2	6 18	71·3	1/11	1·03	17·1
Feeding Treacle	—	—	7 2	0 8	6 14	51	2/8	1·43	1·1
Brewers' Grains :—									
Dried Ale	—	—	7 10	1 2	6 8	49	2/7	1·38	14·0
„ Porter	—	—	7 0	1 2	5 18	49	2/5	1·29	14·0
Wet Ale	—	—	0 18	0 8	0 10	15	-/8	0·36	4.8
„ Porter	—	—	0 13	0 8	0 5	15	-/4	0 19	4·8
Malt Culms	—	—	7 15*	1 11	6 4	43	2/11	1·56	19·9

† At Liverpool. * At Bristol.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of May and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 3s. per ton. The food value per ton is therefore £8 17s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices :—N, 11s. 7d ; P_2O_5, 3s. 7d. ; K_2O, 2s. 9d.

its use is always justified even though it may prove expensive, since the animal will be given a good start in life at the critical period of its career. A check in the early period of life is difficult and expensive to correct at a later stage, so that money saved by economical feeding at an early stage may be lost later in the endeavour to correct for the stunted growth that occurs later. On the other hand, the feeding of adult stock on milk is wasteful, although it is an advantage to feed by-products of milk, butter and cheese if a cheap source of supply is available.

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FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat	1·38	2 7	71·6	9 5	0 14	9 19
Oats	1·38	2 7	59·5	7 14	0 12	8 6
Barley	1·38	2 7	71·0	9 3	0 11	9 14
Potatoes	1·38	2 7	18·0	2 7	0 3	2 10
Swedes	1·38	2 7	7·0	0 18	0 2	1 0
Mangolds	1·38	2 7	6·0	0 16	0 2	0 18
Beans	1·38	2 7	67·0	8 13	1 9	10 2
Good Meadow Hay	1·38	2 7	31·0	4 0	0 13	4 13
Good Oat Straw	1·38	2 7	17·0	2 4	0 7	2 11
Good Clover Hay	1·38	2 7	32·0	4 3	0 19	5 2
Vetch and Oat Silage	1·38	2 7	14·0	1 16	0 7	2 3
Barley Straw	1·38	2 7	19·5	2 10	0 6	2 16
Wheat Straw	1·38	2 7	11·0	1 8	0 4	1 12
Bean Straw	1·38	2 7	19 0	2 9	0 9	2 18

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	Average Price per ton during week ending June 3rd.				
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	13. 2	13.10	12.12	12 17	16. 7
" " Lime (N. 13 per cent.)	...	12.10	...	12.12	19. 5
Sulphate of Ammonia, neutral (N. 21.1 per cent.)	12. 5*	12. 5*	12. 5*	12. 5*	(N)11. 7
French Kainit (Pot. 20 per cent.)	3. 2	3. 0	...	2.15	2. 9
" " (Pot. 14 per cent.)	2.17	2.15	2. 5	2.10	3. 7
Potash Salts (Pot. 30 per cent.)	...	...	3.15	3.15	2. 6
" " (Pot. 20 per cent.)	...	...	2.10	2.12	2. 7
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7.10	7. 2	7. 5	2.11
Sulphate of Potash (Pot. 48 per cent.) ...	12.10	11.15	11. 5	11.10	4. 9
Basic Slag (T.P. 30 per cent.)	...	...	2.12§	...	...
" " (T.P. 28 per cent.)	2.10§	2. 1‡	...	...	...
" " (T.P. 26 per cent.)	2. 6§	1.14‡	...	...	...
" " (T.P. 24 per cent.)	...	1.11‡	2. 0§	...	...
Superphosphate (S.P. 35 per cent.) ...	...	...	3.15	3. 8	1.11
" (S.P. 30 per cent.) ...	3. 7	3. 2	3. 8	3. 2	2. 1
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	9. 0	8. 0	8.10	7.17	...
Steamed Bone Flour (N. ¾, T.P. 60 per cent.)	6. 7†	6. 7†	6. 5	5.10†	...
Fish Guano (N. 7½-8½, T.P. 16-20 per cent.)	...	...	13. 0	...	...
" " (N. 9, T.P. 10 per cent.) ..	...	...	...	12. 5	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station. London prices are for 4-ton lots. ‡ F.o.r. Works.

§ Prices include cost of carriage from works to town named, and at Bristol are for not less than 4-ton lots. Cost to purchasers in other districts will be greater or less according to the distances of different purchasers from the works.

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MISCELLANEOUS NOTES.

Poultry in Orchards.

FRUIT growers do not always realise the great value that poultry can be in their orchards and plantations. It is well known that the soil in orchards is frequently impoverished by years of cropping and failure to manure. Poultry evenly distributed will make good the deficiency of manure in a most convenient and economical way. In addition, the poultry and the eggs from them should pay a good return on the capital invested in stock, houses, appliances. and wire-netting, after deducting the cost of food and management.

The best orchards to keep them in are those of standard or half-standard trees; in orchards of bush or pyramid trees they may do some damage to the buds or fruit. The heavy breeds, such as the White Wyandotte, or the Rhode Island Red, are to be preferred, as they are much less likely than the light breeds, such as Leghorns, to fly up into the branches.

To get the best results from the even spreading of manure and the greatest destruction of insect pests, it is best to divide an acre of orchard with wire-netting into five sections, and to place in each section a house to hold 24 birds. If the cost of this equipment is prohibitive, it might be tried first on a small plot, the effect upon the crops observed, and then extended, if justified, as means and opportunity allow.

Ducks may be kept, if preferred, instead of hens; they can be more cheaply housed and can be kept in bounds by two-foot netting. One of the egg breeds should be selected, such as Runners, or Khaki-Campbells. Ducks are quite as good as hens in supplying valuable manure, and are probably nearly as good as hens in the destruction of insect pests, but ducks cannot scratch, and so they are not quite so good at clearing the ground of grubs and weeds. The destruction of insect pests by poultry will sometimes save the entire fruit crop from destruction.

Professor Theobald, of Wye, made an examination of the crop of a White Leghorn chicken, five weeks old, kept in an orchard in Kent, and killed towards the end of June, and found 190 Pear midge maggots, 127 aphides, 12 red ants, 2 tortrix caterpillars, and 1 beetle. In the crop of a Red Sussex pullet, killed on the 30th April, he found 14 leather jackets, 10 fever flies, 2 wireworms, 4 cutworms, 5 beetles, 50 ants, 7 woodlice, 4 slugs, 1 millipede, and 20 larvæ of the winter moth.

Many of the chief fruit pests drop down from the trees as caterpillars, in order to pupate or form a chrysalis in the ground,

and it is at this stage that the hen or duck intervenes. The wingless females of some pests, such as the winter moth, are caught before they climb up the tree. Some fruit farmers go so far as to say that poultry in orchards do away with the necessity for banding and spraying. That is doubtful, but it is at any rate certain that if poultry are kept in orchards larger and better crops of fruit will be obtained than otherwise.

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Culling of Poultry Stocks.

IN order to obtain the maximum profit from poultry, culling from the stock should go on all the year round. It should start right from the date of hatching. The Ministry's poultry advisers say "Do not retain any chickens which are unduly long in hatching out of a batch which has hatched normally: they are the weak ones and will never pay for rearing. Furthermore, cripples should not be retained, and should bacillary white diarrhœa break out amongst chickens, it is far better to kill the whole batch and to avoid running the risk of retaining any which may survive the disease and eventually find their way into the breeding pen." That piece of advice applies to chickens of all ages. It is folly to retain weak birds which may later in life find their way into the breeding pen.

Amongst young cockerels there will always be some which are outstanding, and these only should be kept for stock, and the surplus well fed and disposed of as early as possible.

The trap-nest is by far the est aid to culling, for by its use the individual performance of each pullet may be ascertained. Not only should the numbers of eggs laid be taken into account, but also their size. It is not necessary to weigh eggs daily, but it is a good practice to set aside three regular days in each month for doing this. Three days are necessary if the work is to be thoroughly carried out, as it should then be possible to get two eggs from every bird in lay. Should there be some pullets which are putting up remarkable records but are laying small eggs, or are small birds for the breed, poultry keepers will not be misled into keeping them for breeding purposes. As many eggs as possible should be obtained from them, and they should then be sold.

Where trap-nesting is not possible, there are other means of selecting birds, though the same reliance cannot be put upon them. In the yellow-legged varieties, for instance, those pullets

at the end of the year—presuming that they have been hatched at the right season—which still retain the bright yellow pigmentation in the beak and legs are usually poor layers and should be noted for disposal.

When considering the selection of breeding stock, drastic culling is essential. It should be remembered that the tendency in fowls is always to revert to the small egg, and only birds laying eggs of $2\frac{1}{8}$ oz. and over should be used for breeding, and they should be of good size and typical of the breed they represent. As regards male birds, great care should be used in selecting those only whose pedigree is known, and here again the large-egg factor is the most important point.

Culling should go on all through the year. It may be found when breeding operations commence that some hens are laying a large percentage of infertile eggs, or that the eggs do not hatch well, or, if they hatch, that the chickens are weakly and do no thrive. These hens should be removed.

Whilst culling is necessary, poultry keepers will not be in too great a hurry to dispose of breeding stock at the conclusion of the breeding season. It often happens that room is urgently required for growing stock, and the breeder is tempted to dispose of his breeding stock to make room for them, but in doing this very valuable breeding stock may be lost. It is not until the following autumn and winter when the progeny come into production, that the true value of a breeding pen can be ascertained. This particularly applies to male birds: if put into the proper cockerel boxes extra labour is entailed, but they can always be run with young cockerels.

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Ormskirk Potato Trials, 1925.

THE National Institute of Agricultural Botany wish to extend an invitation to farmers, potato growers and merchants, and agricultural advisory and administrative officers to visit the Potato Testing Station, Ormskirk, singly or in parties between the 20th July and 28th August, 1925. Visitors will be able to see the official tests of some hundreds of new varieties of potatoes for immunity from wart disease. These are carried out at Ormskirk for the Ministry of Agriculture and Fisheries, which certifies the results. The other trials open to inspection include the Lord Derby Gold Medal Trials and Yield and Maturity Trials of the leading immune main crop potatoes. There are also nearly

two hundred demonstration plots of the chief varieties of British and foreign potatoes, including the varieties certified as immune in 1923 and 1924.

Hitherto the annual summer inspection of these trials has been held on a single day, but it has been suggested that visitors would be able to learn more about the trials if they came in smaller parties on different days. To see whether this is the case, the Institute will not arrange the usual inspection this year but will be glad to receive agriculturists on dates convenient to them.

Secretaries of branches of the National Farmers' Union, and others wishing to organise parties to see the trials should write to the Superintendent of Potato Trials, Potato Testing Station, Lathom, Ormskirk, Lancs, suggesting alternative dates. Individual visitors will also be welcome, but they, too, should make arrangements with the Superintendent at least a week in advance of their visit. Ormskirk is conveniently reached by a frequent service of local trains from either Liverpool or Preston.

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The Fream Memorial Prize.

THE Fream Memorial Prize, which is annually awarded by the Ministry to the candidate who obtains the highest marks in the examination for the National Diploma in Agriculture, has been won this year by Mr. Harry O. Hirst, a student of the University of Leeds. The value of the prize this year is about £7 10s., which is to be devoted to the purchase of books.

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Harvest Wages.

THE following Agricultural Wages Committees have made Orders or issued Proposals in respect of special rates of wages for this year's harvest.

ORDERS MADE.

Derby.—Special overtime rates for all male workers employed on the Hay and Corn Harvests, the rate in the case of male workers 21 and over being 9d. per hr.

Dorset.—Special overtime rates for all male workers employed on the Hay and Corn Harvests, the rate in the case of male workers 21 and over being 10d. per hr.

Devon.—Special overtime rates for all male workers employed on the Hay and Corn Harvests, the rate in the case of male workers 21 and over being 10d. per hour.

Hants. and Isle of Wight.—Special overtime rates for all male workers employed on the Corn Harvest only, the rate in the case of male workers 21 and over being 9d. per hr.

Hertford.—Special overtime rates for all workers employed on the Hay Harvest only, the rate in the case of male workers 21 and over being 10d. per hr., and female workers 19 and over 7¾d. per hr. N.B.—The Hertford Committee met on 27th June to decide whether to fix special rates for the corn harvest.

PROPOSALS OUTSTANDING.

Cambridge.—Corn Harvest. Male workers 21 and over, minimum rate of 60s. for 63 hours per wk. (excluding Sunday), with overtime rate of 1s. 6d. per hr. Female workers 18 and over, minimum rate 11d. per hr. for 63 hours (excluding Sunday), with overtime rate of 1s. 2d. per hr. The proposal includes less rates for younger workers. Any objections to the proposal must be lodged with the Committee before the 3rd July.

Essex.—Corn Harvest. Male workers 21 and over employed on farms containing more than 60 acres of corn and who work the full harvest period, a bonus of not less than £5 5s. shall be payable to cover all overtime employment. Less rates of bonus are proposed for younger workers. Male workers of 21 and over employed on farms containing 60 acres of corn or less, 10½d. per hr. for harvest work; less rates are proposed for younger workers. Female workers 21 and over 7½d. per hr. for harvest work, with less rates for younger workers. Any objections to the proposal must be lodged with the Committee before 11th July.

Norfolk.—Corn Harvest. Male workers 21 and over who work the full month or the full harvest period a bonus of £12. For male workers who do not work the full period a minimum rate of 29s. for a wk. of 50 hr., with overtime payment at 9½d. per hr. The proposal also includes lesser rates for younger workers. Any objections to the proposal must be lodged with the Committee before the 27th June.

Suffolk.—Corn Harvest. Male workers 21 and over who work the full 24 days or the full harvest period a bonus of not less than £6 3s. 4d. shall be payable to cover all overtime employment; less rates of bonus are proposed for younger workers. Any objections to the proposal must be lodged with the Committee before 4th July.

Yorks, East Riding.—Corn Harvest. Male workers 21 and over, not boarded and lodged by their employer, 1s. 3d. per hr. For special classes boarded and lodged by their employer 1s. per hr. Female workers 16 and over 11d. per hr. The proposal also includes lesser rates for younger workers. Any objections to the proposal must be lodged with the Committee before the 13th June.

Copies of the above Orders and Proposals can be obtained on application to the Ministry.

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Farm Workers' Minimum Wages.

MEETINGS of the Agricultural Wages Board were held on the 26th May, and 15th June, at Gwydyr House Annexe, Whitehall, S.W.1, the Chairman, Lord Kenyon, presiding.

The Board considered notifications from various Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and proceeded to make the following Orders carrying out the Committees' decisions:—

Derby.—From 22nd June special overtime rate of 9d. per hr. for male workers 21 and over employed on the Hay and Corn Harvests in 1925. Lesser rates for younger workers.

Devon.—From 16th June to 25th March, 1926, minimum rates for male and female workers. From 6th July to 25th March, 1926, overtime rates for male workers, including special overtime rates for the Hay and Corn Harvests. In the case of male workers aged 21 and over the minimum rate is 32s. 6d. per wk. of 52 hr. from 16th June to the 30th Sept., and of 50 hr. from 1st Oct., 1925, to the 25th March, 1926, with overtime rates at 8½d. per hr. on week-days and 10d. per hr. on Sundays, and special overtime rates for the Hay and Corn Harvest at the rate of 10d. per hr.

Hants. and Isle of Wight.—From 22nd June. Special overtime rates of 9d. per hr. for male workers 21 and over, employed on the Corn Harvest in 1925. Lesser rates for younger workers.

Hertford.—From 8th June. Special overtime rates for all workers on the Hay Harvest in 1925. The rate for male workers aged 21 years and over is 10d. per hr., and for female workers aged 19 years and over 7¾d. per hr. Lesser rates are provided for younger workers

Stafford.—From 28th June (when the previous Order expires) male workers 21 and over 31s. 6d. per 54 hr., with differential overtime rate of 9d. per hr. Lesser rates for younger workers.

Pembroke and Cardigan.—From 2nd June (when the previous Order expired) to 30th Sept., 1925, male workers 21 and over 30s. for 50 hr. in winter (first Monday in October to last Sunday in February), and 54 hr. in summer, and female workers 18 and over 5d. per hr. for a day of 8 hr. Proportionate rates for younger workers, and differential overtime rates, the latter in the case of adult male workers being 8d. per hr. on week-days, 9d. per hr. first 3 hr. on Sunday, and 10½d. per hr. for subsequent hours on Sunday: and for female workers 18 and over 6d. per hr. on week-days, 6½d. per hr. first 3 hr. on Sunday, and 7½d. for subsequent hours on Sunday.

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The Agricultural Index Number.

THE general level of the prices of agricultural produce was further reduced during May, but the decline as compared with April was small. On the average prices were 57 per cent. above those in the corresponding month of 1911-13, a fall of 1 point on the month but 13 points below the level of January. From

August, 1924, to April of this year the index numbers have been appreciably higher than a year earlier, but in May the increase over 12 months ago was only 1 point.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920 :—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.	1925
January ...	200	183	75	68	61	70
February ...	195	167	79	63	61	67
March ...	189	150	77	59	57	65
April ...	202	149	70	54	53	58
May ...	180	119	71	54	56	57
June ...	175	112	68	51	58	—
July ...	186	112	72	53	52	—
August ...	193	131	67	54	59	—
September	202	116	57	56	60	—
October ...	194	86	59	51	63	—
November	193	79	62	53	64	—
December	184	76	59	56	63	—

Wheat averaged 4d. per cwt. more than in April, but this increase was relatively smaller than in the base years, and the index figure declined by 8 points to 59 per cent. above 1911-13. Oats showed a relatively sharper increase of 7d. per cwt., while barley declined by 2d. per cwt., the index numbers of both these cereals being comparatively low at 36 per cent. above pre-war. Wheat remained appreciably dearer than in the previous two years, but barley was cheaper than in May, 1924, and oats only 5d. per cwt. dearer.

The index number for milk declined by 8 points to 55 per cent. above 1911-13, the reduction being due to lower prices for May in the Manchester district, owing to some extent to excess deliveries. Butter prices fell by $3\frac{1}{4}$d. per lb. on the month, this drop being sharper than in pre-war years, and the index number declined by 10 points. On the other hand, cheese advanced by 2s. per cwt., and sold at 70 per cent. more than in 1911-13, a rise of 9 points on the month. Eggs were $\frac{3}{4}$d. per dozen dearer than in April. but the index number was reduced from 51 to 48 per cent. above 1911-13, as the rise was not so sharp as in the base years.

Prices of fat cattle have been very steady, average prices per stone dead-weight showing practically no change for some months, but as there was a rise in the spring in the base years the index numbers have been falling slowly. Fat sheep declined 1d. per lb. on the month, but this reduction was no sharper than in pre-war years. Fat pigs were also cheaper—by 8d. per stone dead-weight—and the index numbers fell by 7 and 8 points to

60 per cent. above pre-war. Apart from store pigs which became cheaper, there was little change in the level of prices of store stock.

Prices of old potatoes, after rising each week from the beginning of April, weakened considerably in the second week of May, and there was a further sharp fall in the last week of the month. Over the month, however, the prices averaged 2¼ times those of May, 1911-13. Last year's main crop potatoes, which are now practically all cleared, have been sold throughout the season at from 2 to 2½ times pre-war prices. Hay became slightly dearer in May, but this crop continues to sell at practically the same level as in 1911-13. Cabbage rather unusually advanced in price in May, and the index number advanced to 89 per cent. above pre-war, but cauliflowers became cheaper and were at 80 per cent. above 1911-13, a fall of 7 points on the month. Carrots became appreciably dearer, but the rise was not so sharp as usual and this vegetable was little dearer than in May, 1911-13.

Index numbers of different commodities during recent months and in May, 1923 and 1924, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

Commodity.	1923. May.	1924. May.	1925. Feb.	1925. Mar.	1925. April.	1925. May.
Wheat ...	37	38	83	79	62	59
Barley ...	16	46	59	45	38	36
Oats	42	30	42	38	34	36
Fat cattle ...	53	51	53	51	50	49
Fat sheep ...	103	87	100	97	100	100
Bacon Pigs ...	64	29	62	67	68	60
Pork " ...	76	33	60	66	67	40
Dairy cows ...	50	58	50	48	47	48
Store cattle ...	33	42	46	43	39	40
Store sheep ...	98	96	100	104	100	99
Store pigs ...	126	36	48	47	64	55
Eggs... ...	43	40	62	49	51	48
Poultry ...	77	87	56	57	50	55
Milk	63	50	84	82	58	55
Butter ...	40	40	62	58	64	54
Cheese ...	42	77	50	57	61	70
Potatoes ...	—28*	212	144	138	115	124
Hay	41	4	0	—1*	—2*	3

* Decrease.

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Harvest Weather Forecasts by Wireless.

FARMERS and many others will no doubt welcome the news that the British Broadcasting Company has been able to arrange for the broadcasting of a morning weather forecast from their high-power station at Chelmsford at 10.30 a.m., summer time, from 1st July, the work to be transferred later to the high-power station at Daventry as soon as that station is brought into use. The Ministry believes that this forecast will be of real use to farmers in conducting their harvesting operations, and is satisfied that, under present circumstances and conditions, it is not possible to broadcast a morning forecast earlier than 10.30. Although it should be useful to many classes of people, including holiday makers, the forecast will be specially prepared by the Meteorological Office of the Air Ministry for the needs of farmers, and will therefore usually refer to rainfall, temperature and cloud only. As the weather is seldom the same over any large extent of country, different forecasts will be given for different districts. These districts cannot be permanently fixed without making them unduly numerous, but will be chosen each day in accordance with the weather situation. The district to which each forecast will apply will be given in general geographical terms, such as "Central and Eastern England," "Scotland and Northern England," etc. The number of districts for which forecasts are given on any one day is not likely to be more than three, and will always be as few as possible. Each listener should therefore wait until a district is called which includes his locality, and then take the forecast which follows.

The forecasts will apply to the twelve hours after they are issued, that is until 10.30 in the evening. The farmer will, however, generally be as much interested in the possible changes in the weather thereafter, and to meet this need, a short paragraph will follow the forecasts giving what is called "further outlook." This will be a short statement applying to the whole country, and will give a general idea of what changes in the weather are expected. The forecasts and further outlook give the conclusions reached by the Meteorological Office as to the weather to be expected, but do not contain any reasons for reaching these conclusions. These reasons are based, as is well known, on the pressure and wind distribution as shown by the charts prepared in the Meteorological Office. A paragraph added after the further outlook will give a short description in words of the pressure distribution and the inferences which may be

drawn from it regarding the weather. This paragraph will be called the "General Inference."

A word as to the best use which can be made of these special weather forecasts may be desirable. It is not intended that they should replace altogether the farmer's own judgment regarding the future weather. The weather is frequently very local in its distribution, and it would be quite impossible to issue forecasts which would be correct for every locality. The official forecasts should therefore be considered as aids to the farmer in forming his opinion. They should be looked upon as giving the *type* of weather to be expected. The Further Outlook section should prove of much value as a general rule, as it will indicate the direction in which it is anticipated that changes will take place. To those who have a smattering of knowledge of modern meteorology, the General Inference may prove specially informative. We all know that a falling barometer is recognised as an indication of approaching bad weather, while a rising barometer generally indicates clearing weather. These relationships are really based on the weather associated with cyclones and anti-cyclones, and if one knows where the cyclones are situated, the movements of the barometer and changes in the weather can be interpreted with greater confidence.

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Agricultural Shows.

A FEW words on agricultural shows in general and the Royal Agricultural Show in particular may be of interest to many farmers and also to others of the general public. The "Royal" Show this year takes place at Chester from 7th to 11th July. During that time Chester will be the "Mecca" of the farming community of this country. It is hardly sufficiently realised how gigantic an undertaking the Royal Show has become. It is the common meeting-place once a year of all that is best in agriculture. The animal exhibits are the masterpieces of the breeder's art, the agricultural machinery is the last word in thorough-going British excellence —to say nothing of the many useful foreign exhibits, and the horticultural exhibition is usually of a most interesting and instructive character. In addition, there are exhibits of all kinds of agricultural produce, dairy, poultry, and so on, and of agricultural requirements, seeds, fertilisers, etc., and agricultural accessories. There are competitions in horse-shoeing, demonstrations of butter and cheese-making, with lectures on

them and on dairying and bee-keeping, whilst all the time judging of cattle, horses, ponies, pigs, and poultry, is going forward under the control of the greatest authorities in the country. The whole comprises a very great show indeed, requiring exceptional powers of organisation and understanding of agriculture in order to be what it is, always an assured success. This year the show ground covers no less than 160 acres.

It may be added that short addresses on the Ministry's dairy exhibit will be given daily in the Ministry's pavilion, and all interested in dairying are invited to attend.

It will be interesting to look for a moment at the beginnings of such shows. They can be traced back for more than a century, when Sir John Sinclair, a President of the old Board of Agriculture, said in a speech which he made after the second show of the Highland and Agricultural Society in 1823:—

"I have long wished to see meetings assembled . . . . for promoting the improvement of our live stock, and I am happy to find that . . . . they have commenced . . . . . with so much probability of success.

"Such meetings are of great use in various respects; they are the means of circulating valuable information, they excite a spirit of improvement, and much advantage is derived from the discussions which they occasion, and from the opportunities which they afford of viewing the various descriptions of stock which a country possesses, and comparing their respective properties and defects. A Bakewell or a Culley, by great skill, ability and perseverance may do much in ameliorating any particular breed, but the improvement of the general stock of a nation can never take place without such meetings as the one we have this day witnessed."

These observations of 1823 hold as good in 1925. There are now, of course, many large agricultural shows, and a long series of smaller ones up and down the land, and they all serve the excellent purpose which Sir John Sinclair pointed out, of showing the best examples of farm produce for the emulation of the farmer. They also serve to inform the public of the importance of agriculture. A century ago that was not so necessary, for in 1801 our population was only 9 millions, most of whom were resident in the country. We have now, however, become mostly town-dwellers, and according to the last census figures, over 30 of our 38 millions are dwellers in the towns, and under 8 millions, or only one-fifth, in rural areas.

Number and Declared Value of Animals Living, for Breeding, Exported from Great Britain and Northern Ireland in the three months ended March, 1925, compared with the corresponding period in 1924.

(From Returns supplied by H.M. Customs and Excise).

Country to which Exported	Jan. to March, 1925		Jan. to March, 1924	
	Number	Declared Value	Number	Declared Value
CATTLE		£		£
Argentina	137	34,667	11	4,025
Denmark	29	1,260	0	0
Uruguay	24	4,796	6	765
Irish Free State	1,028	17,018	693	11,031
India	10	355	1	13
Ceylon	3	230	0	0
New Zealand	0	0	22	1,535
Union of South Africa ...	20	1,850	14	1,100
Rhodesia	2	120	0	0
Kenya Colony	16	966	0	0
Other Countries	9	800	5	161
Total of Cattle	1,278	62,062	752	18,630
SHEEP AND LAMBS				
Argentina	245	7,099	93	1,793
Peru	90	1,156	6	203
Uruguay	32	975	17	375
Irish Free State	79	248	38	130
Union of South Africa ...	25	326	21	230
Kenya Colony	9	172	0	0
Other Countries	5	78	1	100
Total of Sheep and Lambs	485	10,054	176	2,831
SWINE				
Argentina	6	115	11	498
Belgium	30	200	0	0
Egypt	0	0	3	60
France	5	34	7	136
Germany	6	397	0	0
Japan	0	0	6	202
Peru	5	95	0	0
Irish Free State	119	533	115	183
India	0	0	5	100
Union of South Africa ...	4	90	3	80
Falkland Islands	0	0	14	134
Other Countries	7	167	0	0
Total of Swine	182	1,631	164	1,393

Foot-and-Mouth Disease: Withdrawal of Restrictions.

FROM 1st January, to 7th May, 1925, 21 outbreaks have occurred in nine counties, involving the slaughter of 784 cattle, 349 sheep and 560 pigs, and the payment of £30,452 in compensation.

The Minister has issued an Order the effect of which is to withdraw as from 4th June all general restrictions imposed by the Ministry in connection with the outbreaks of foot-and-mouth disease which occurred in Cheshire, Northants, and Warwickshire on the 5th, 6th and 7th May respectively.

There are now (25th June) no general restrictions in connection with foot-and-mouth disease in force in any part of Great Britain for the first time since the widespread outbreak which commenced in August, 1923.

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NOTICES OF BOOKS.

Gold Coast Plant Diseases.—(R. H. Bunting and H. A. Dade. The Crown Agent for the Colonies, 4, Millbank, Westminster, London, S.W.1. Price 6s., postage 4d.) "In a country where agriculture is almost entirely in the hands of a primitive people and mycological effort in the feeble stage of infancy, an initial work of a general nature on the subject of plant diseases can be little better than a notebook. Such is this; and it is published with an invitation to all local observers to consider it as a nucleus to which any addition from them will be welcomed." This extract from the Preface fairly indicates the nature and scope of the present modest book of 124 pages. It opens with a clearly written elementary account of what is meant by disease, of the symptoms of disease and of the various causes of disease, including those of an inorganic nature and those due to parasites, both animal and vegetable. Special attention is given to fungus diseases; and the nature, mode of life and means of dissemination of fungi are concisely dealt with. Measures of control are discussed, including control by legislation; and the importance of intelligent, public-spirited co-operation in regard to such control is insisted upon.

The second and third chapters are devoted to diseases of Cocoa, chapter 4 to various diseases of other permanent crops, such as Coffee, Cola, Rubber, Citrus, Palms, etc., whilst chapter 5 covers the diseases of annual plants, such as beans, cassava, cotton, rice, tobacco, and several others. The descriptions of the diseases are set out in clear, succinct terms, and the causative organisms are dealt with in not too technical a fashion. Four clear and boldly printed coloured plates illustrate three serious pod diseases and the "White Root" disease of cocoa respectively. In addition, twenty-one plates of excellent half-tone illustrations of many of the diseases dealt with in the text,

printed on art paper, are provided; and they add very considerably to the value and usefulness of the book. From a perusal of chapter 5 on the local legislative measures which have been found necessary to protect crops (especially the cocoa crop) from losses due to diseases, it will be seen that the difficulties with farm owners and others are considerable. Apathy seems already to have resulted in considerable loss of potential wealth, and persistent neglect will eventually lead to disaster. As an aid to removing this apathy and as a means of spreading important knowledge concerning the diseases which have to be fought and the best methods of combating them, this book should serve a very useful purpose. In the concluding chapter 7 there is given a list of fungi collected in the Gold Coast Colony and its Dependencies, with notes on localities and substrata on which they were collected. This will serve to make the book of interest to all who are concerned with mycology in tropical countries. A glossary of the relatively few technical terms employed, as well as a good index, is supplied, while in order to practice to some extent what it preaches the book has been bound with a solution which renders it impervious to the ravages of insects.

The British Goat Society's Year Book for 1925 (issued by the Hon. Secretary, 10, Lloyd's Avenue, E.C.3; price 1s. 6d.) contains much interesting and valuable information. The Honorary Secretary, Mr. Thomas W. Palmer, contributes a foreword in which he refers to the practical immunity of the goat from tuberculosis, citing in this connection statistics which show that only 0.091 per cent. of the goats slaughtered in Holland during the period 1911-1920 were found to be infected with the disease. Encouraging messages from the President, the Earl Bathurst, and from the Chairman of the Committee, are followed by a number of articles on matters of interest to goat-keepers. Among these Mr. J. A. Caseby gives his views on "Tethers and Tethering"—always a vexed question where goats are concerned; Mr. J. L. Whytehead writes on the "Stud Goat Scheme"; Miss D. G. Saker on "Goats' Milk Cheese," and Lady Helen Graham has a useful paper on "Goat Breeding."

The scientific aspect of goat-keeping is represented by chapters dealing with such subjects as "Proteins," by J. C. Urquhart; "Rickets," by F. H. Stainton; "Horn Inheritance in Goats," by C. J. Davies; and "Mendelism and the Goat Breeder," by S. A. Asdell. Hitherto little has been known of inheritance in goats, but the last-named writer indicates that investigations are in progress which, it is hoped, will have important results for the goat-breeder. Dr. Wright gives some striking examples of the beneficial effects of goats' milk as a food for infants.

Dr. Crew contributes some "Notes on the Genetical Aspects of Fertility and Sex Ratio," while F. Knowles and J. C. Urquhart collaborate in providing some valuable "Notes on the Composition of the Fat of Goats' Butter." There are 180 pages of letterpress, and over 40 well-produced illustrations, among which may be mentioned a photograph of Didgmere Dulcie, whose record milk yield of 4,187 lb. in 311 days gives some idea of the possibilities of the goat as a milk producer. Goat-keepers will find this book a most useful and interesting compendium of information.

An Introduction to Sexual Physiology.—(F. H. A. Marshall, F.R.S. London: Longmans, Green & Co., 150 pp. and Index. Price 7s. 6d.) This handbook deals with a number of subjects which are of importance to farmers. It is a remarkable fact that the ordinary curriculum of the Agricultural Colleges rarely includes Animal Physiology, and never that important technical aspect of the subject with which this book deals. The modern curriculum for a degree in agriculture still adheres to the fashion set by Prof. Wallace in Edinburgh fifty years ago: he did not include physiology in his classic curriculum, and, although the sciences bearing on agriculture have since received many recruits, sexual physiology has not been one of them, except at the school to which the author is attached. The stock-raising interest, however, in which horse-breeding is included, easily occupies the first place, economically, among the farming industries of this country. We can confidently recommend this text-book to everyone interested in animal breeding, as all stock breeders must be. The general ignorance that prevails regarding the fundamental facts of reproduction is remarkable: here will be found every conceivable detail lucidly explained and illustrated. The author is the leading authority on the subject in this country and it is fortunate that he has devoted so much of his time to experiments with farm animals. His investigations on the pig (with the late K. J. J. Mackenzie as collaborator) are well known, and much light has also been thrown on fertility and sterility of the cow and the ewe. These and other matters are treated in this admirable text-book. He requires no excuse for concluding his treatise with a statement of his views on Eugenics, for he is entitled to speak with authority.

Cattle Breeding: Proceedings of the Scottish Cattle Breeding Conference.—(Edited by G. F. Finlay, Ph.D. London: Oliver & Boyd. 12s. 6d. net.) Just before last year's Highland Show a Scottish Cattle Breeding Conference was held in Edinburgh, and this volume is a record of its proceedings. The conference was attended by many of the most eminent scientists and students of animal husbandry in Great Britain and Ireland, and delegates came from the Dominions, the United States and the Continent. A large number of papers, most of which were followed by illuminating discussions, were read. The great variety of the problems which confront the breeder naturally led to a wide divergence in the subjects of the papers; it is a little to be regretted that the volume of the discussions which took place has prevented their inclusion in addition to the papers. It has also been found necessary to edit the papers with a view to economy of space.

The papers have been classified under three headings:—(1) Scientific Aspects of Cattle Breeding; (2) Reviews of Cattle Breeding Investigations; and (3) Reviews of Cattle Breeding in various Countries; but it is obvious that, whatever aspect of the breeding problems is attacked, most of the papers necessarily deal with "inheritance" as applied to some particularly desired characteristic. Part 3 deals with the rule of thumb methods adopted by practical men, who are actively engaged in large scale production all over the world, and from that point of view should be of most interest to breeders in Great Britain. Parts 1 and 2 detail some of the results obtained by scientific investigation, which are applicable to the practical problems of cattle husbandry, and a study of these sections should prove helpful to all classes of the breeding community.

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NOTES FOR THE MONTH.

British Breeds of Live Stock.

The Ministry has published a fourth edition of its handbook "British Breeds of Live Stock" (Miscellaneous Publications No. 7, obtainable from the Ministry, 10, Whitehall Place, London, S.W.1, price 3s. 6d. net, post free). This handbook was first published in 1910, and is a useful and reliable guide to intending purchasers both in this country and abroad who desire to obtain British live stock of any particular breed and qualification.

The volume contains a detailed account of the characteristics of the British breeds of horses, cattle, sheep and pigs, and a brief history of the origin of each breed, together with useful information upon the uses of the breed, its value for crossing, the various countries overseas in which it has been established, and from which there is a demand for live stock.

This information is supplemented by over 90 photographs of specimen animals. A complete list of breed societies and a note of the principal places of public sales, exhibitions and shows in this country are also included, together with particulars of average prices of different classes of animals.

While the handbook is of considerable value to those interested in the export of British live stock, the Ministry would commend the publication to the notice of all farmers who wish to improve the standard of their herds from both a commercial and breeding point of view, by the introduction of the most suitable type of animals for their purpose.

* * * * * *

Economic Resources of Canada.

In the summer of 1924, the Ministry learned that Sir Henry Rew, who was visiting Canada in connection with the meeting of the British Association at Montreal, would be willing to make a general inquiry, so far as was possible within the limits of a short visit, into the agricultural resources and output of Canada in relation to the food supplies and agri-

cultural production of Great Britain. Sir Henry Rew was therefore invited to make a Report on these lines, both on account of the intrinsic interest of the subject and also in view of its direct bearing on the investigations which the Ministry are conducting into agricultural economic questions and methods of marketing.

The Report, which extends to 128 pages, has now been published—Economic Series No. III, Economic Resources of Canada, by Sir Henry Rew, K.C.B., price 1s. 6d., postage 1½d., obtainable direct or through any bookseller from H.M. Stationery Office, Adastral House, Kingsway, W.C.2, and Manchester, Cardiff and Edinburgh.

* * * * * *

Tuberculosis Order, 1925.

FOR some time past, the Government has had under consideration the question of reviving the Tuberculosis Order of 1914. After consultation with the Ministry of Health, the Ministry of Agriculture has issued an Order containing provisions similar to those of the 1914 Order. The new Order comes into force on 1st September next, that being the date on which the Milk and Dairies Consolidation Act, 1915, in England and Wales, and the Milk and Dairies Act, 1914, in Scotland, will take effect. Both these Acts prohibit the use, for the production of milk, of any cow which is giving tuberculous milk or is suffering from tuberculosis of the udder or tuberculous emaciation. The Order will compel the slaughter of all such cows and any other bovine animal which may be suffering from tuberculous emaciation or from a chronic cough and showing definite clinical signs of the disease.

The owner will be required to report to the police any case of a cow suffering from indurated udder or other chronic disease of the udder, as well as any bovine animals suffering from the other above-mentioned forms of tuberculosis. Veterinary practitioners who find such cases amongst animals which they visit in the ordinary course of their practice are also required to report the fact to the local authority. Animals found affected, after full veterinary inquiry, will be slaughtered and compensation paid at the rate of three-quarters of the market value, if found to be suffering from non-advanced tuberculosis, and one-quarter if affected in an advanced form, subject to a minimum payment of 45s. An important provision in the Order is to prohibit the landing of any bovine animals from Ireland, Canada

or elsewhere which are affected with tuberculosis. Any such animals landed in contravention of the Order will be slaughtered in the landing places without compensation. The expenses of carrying out the Order will fall upon the local rates, but a Bill is at present before Parliament empowering the Ministry to refund out of the Exchequer three-quarters of the amount paid by local authorities in compensation for slaughtered animals.

The new Order represents the most that is practicable at the present time in the direction of securing the eradication of bovine tuberculosis, and, in contributing to the production at the source, of a milk supply free from bovine tubercle bacilli.

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Committee for Tests of Agricultural Machinery.

THE Right Hon. Edward Wood, M.P., Minister of Agriculture and Fisheries, has appointed a Committee to supervise, on behalf of the Ministry, the conduct of tests of agricultural machinery.

It consists of the following :—

Mr. W. C. Dampier Whetham, F.R.S. (*Chairman*).

Mr. Harry German.

Mr. J. H. Hyde, of the National Physical Laboratory.

Mr. L. A. Legros, O.B.E., M.I.M.E.

Mr. B. J. Owen, D.Sc., Director of the Institute of Agricultural Engineering, Oxford.

The duties of the Committee will be :—

(*a*) To consider all applications made to the Ministry for tests of individual machines and inplements;

(*b*) To recommend, where no scale has been laid down, the fees to be charged;

(*c*) To formulate details of individual tests;

(*d*) To recommend the Institutions at which, and the persons by whom, individual tests are to be conducted; and

(*e*) To draw up certificates and reports for approval and issue by the Ministry.

In cases where special knowledge is required for tests, or particular forms of test, of any class or classes of agricultural machine or implement, the Committee may for the purpose of such tests, co-opt one or more additional members.

The Secretary of the Committee is Mr. P. Barker, of the Ministry of Agriculture and Fisheries.

Prosecutions under the Agricultural Wages Act.

THE Agricultural Wages Act imposes on the Ministry the duty of securing the proper observance of the Act, and with this object in view two prosecutions were recently instituted by the Ministry. In one case at Epping, Essex, the employer was charged with paying a worker in agriculture at less than the minimum rate of wages prescribed by Orders made under the Agricultural Wages Act, and the Bench imposed a fine of £6 and ordered the employer to pay court fees and the arrears of wages, which amounted to nearly £12. The second case involved a similar charge against a farmer at Brigg, Lincolnshire, and the Bench in this case imposed a fine of £1 and ordered the employer to pay costs and arrears of wages.

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Ministry's Research Exhibit at Wembley.

THE Ministry's exhibits dealing with agricultural research, staged in the Pavilion of H.M. Government at the British Empire Exhibition, have more than once been the subject of a note in this *Journal* (see May, 1925, p. 103, and June, 1925, p. 194). Small changes in the arrangement of the exhibit have recently been made in order to effect improvements, and a new exhibit of preserved fruit, supplied by the Fruit and Vegetable Preservation Research Station at Campden, has been added.

A word may be said as to the nature of the exhibits in question. The Ministry is not blind to the fact that, given different conditions, more space and more liberal financial assistance, an agricultural exhibit of quite another character would not only have been more desirable but could have been organised. It is to be remembered, however, that Great Britain is not a food-exporting country, but a food-buyer on the grand scale. For this reason alone a big display of home produce is hardly called for in the same way that it is in the case of the great Dominions—whose main objects must necessarily be to demonstrate what they can produce and the attractive surroundings in which it is produced, and thus secure business for their producers. From the outset, therefore, it was felt that the most appropriate type of exhibits which could be arranged, taking into consideration the space and funds at disposal, would be a series dealing with the main features of agricultural

Photo by] [Topical Press Agency.

research, and the plan adopted was endorsed by an informal committee which met to consider the question before the Exhibition opened in 1924.

A descriptive account of the exhibits is given in a Guide which has recently been issued and which can be obtained direct from the Ministry.* Visitors to Wembley who propose to see the agricultural research exhibits should obtain this Guide in advance. When seeing the exhibits visitors who require any further information should consult the Guide-Lecturer, Dr. G. F. Finlay, who will gladly give every help in his power. Parties of farmers or students may make advance arrangements to be conducted round the Ministry's research exhibits, so that they may make the fullest use of them. Correspondence to this end should be addressed to *Dr. G. F. Finlay, Ministry of Agriculture Gallery, Pavilion of H.M. Government, British Empire Exhibition, Wembley.*

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The Ministry's Exhibits at Agricultural Shows.

A NOTE on the Ministry's agricultural research exhibit at Wembley is given above. It may usefully be added that the Ministry also exhibits at a number of the larger agricultural shows, and has already this year sent exhibits to the Devonshire Show at Plymouth (12th-14th May), the Bath and West Show at Maidstone (28th May-2nd June), the Three Counties Show at Hereford (9th-11th June), the Lincolnshire Show at Grantham (24th-26th June), the Royal Agricultural Society's Show at Chester (7th-11th July), the Royal Isle of Wight Show at Newport (16th July), and the Yorkshire Show at Bradford (22nd-24th July).

It may be said that the large number of visitors to see the Ministry's exhibits, and the interest displayed, have been distinctly encouraging, showing an increasing desire to learn more about the directly scientific aspects of farming, with the object of applying them to the business of food production. In general the exhibits deal with plant breeding, seed testing and weeds, apple packing, rat destruction, fruit preservation, poultry and rabbit keeping, bee-keeping, rural industries, plant pests, improvement of grass land, and clean milk production. The Ministry's publications are also strongly represented, and on sale.

* Guide to the Exhibit of the Ministry of Agriculture, British Empire Exhibition (33 pages), 1925, price 3d. (post free).

This season the Ministry has been enabled, by means of a special grant, to add an exhibit devoted to dairying, illustrating the main directions in which dairy farmers are being assisted by education and research at the present time. The exhibit, which has attracted much attention, was prepared with the assistance of dairying authorities, particularly the National Institute for Research in Dairying, Reading. A part of it was set aside for a demonstration of the food value of milk, displayed by the National Milk Publicity Council. At the Royal Show a further innovation was the giving of short addresses of about a quarter of an hour's duration four times daily, on subjects of special interest to dairy farmers, and bearing on the exhibit. The lecturers were Dr. Stenhouse Williams, Mr. James Mackintosh and Capt. J. Golding (National Institute for Research in Dairying), Capt. F. J. W. Thornycroft and Mr. P. A. Mytton (Ministry of Agriculture and Fisheries), Mr. R. Boutflour (Agricultural Organiser for Wiltshire), Miss Davidson (National Milk Publicity Council), Mr. W. A. C. Carr and Mr. D. M. Smillie (Reaseheath Farm Institute, Cheshire).

At the Royal Show the Ministry's Pavilion (see photograph) was visited by H.M. the King, who was conducted by Sir Gilbert Greenall (President of the Royal Agricultural Society), and the Rt. Hon. E. F. L. Wood, M.P. (Minister of Agriculture and Fisheries).

Other shows at which it is proposed that the Ministry shall exhibit this year are the Royal Welsh Show at Carmarthen (5th-7th August), the Imperial Fruit Show in London (30th October-7th November) and the Fat Stock Shows at Norwich, Birmingham and Smithfield in November and December.

* * * * * *

The Agricultural Index Number.

THE general level of the prices of agricultural produce was again reduced in June, thus continuing the fall which has taken place each month since January. On the average prices were 55 per cent. above those of the corresponding month of 1911-13, against 57 per cent. in May. The decline was due to the sharp fall in potatoes and the lower prices of fat sheep and pigs. This is the first month since July, 1924, in which the index number has been lower than a year earlier. In June last

year the general level of agricultural prices was 58 per cent. above pre-war, the lower price of potatoes this year being more than sufficient to account for the difference on the year.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.	1925
January ...	200	183	75	68	61	70
February ...	195	167	79	63	61	67
March ...	189	150	77	59	57	65
April ...	202	149	70	54	53	58
May ...	180	119	71	54	56	57
June ...	175	112	68	51	58	55
July ...	186	112	72	53	52	—
August ...	193	131	67	54	59	—
September	202	116	57	56	60	—
October ...	194	86	59	51	63	—
November	193	79	62	53	64	—
December	184	76	59	56	63	—

The quantities of old potatoes held over to the end of the season were rather heavier than was necessary, and a sharp fall in prices set in during the fourth week of May, but even so the average level of prices during June was 76 per cent. above pre-war. Wheat and oats were 3d. per cwt. dearer on the month, but the price of wheat has now been falling for two or three weeks. The index number of wheat rose by 3 points to 62 per cent. above pre-war, and that of oats advanced from 36 to 38 per cent. above 1911-13. Barley dropped 2d. per cwt., but this fall was relatively less than is usual in June, and the index number rose by 2 points. As compared with June of last year, wheat and oats are dearer but barley is cheaper. Hay remains very steady at practically pre-war prices.

Fat cattle reached their maximum price for the year in the first week of June and have since become cheaper. Over the month they averaged slightly less than in May, but the decline was rather smaller than in the basic years and the index number rose by 1 point to 50 per cent. above 1911-13. The reduction of 1d. per lb. in the average price of fat sheep was, however, much sharper than in 1911-13, and the index number declined by 7 points to 93 per cent. above pre-war. Fat pigs also showed a relatively sharper reduction than usual, and the index figures dropped from 60 per cent. above pre-war in May to 54 per cent. for baconers and 53 per cent. for porkers. As compared with a year ago fat cattle are rather cheaper, fat pigs appreciably dearer, while sheep are selling at similar prices.

Dairy cattle became cheaper in the early weeks of June, but with the pastures becoming rather burnt the demand improved latterly, and over the month there was little change in the index number. The recent shortage of grass has affected the demand for store cattle, but earlier in the month prices were higher than in May and the index number shows a rise of 3 points to 43 per cent. above pre-war. Store sheep were relatively dearer than in May, the decline in prices being less than in the basic years, while the index number for store pigs remains unaltered although prices were reduced slightly.

Contract prices for milk were the same for June as for May. Butter averaged ½d. per lb. less on the month, but the index number advanced 3 points to 57 per cent. above pre-war, whilst with only a trifling increase in the price of cheese the index number rose by 8 points to 78 per cent. above 1911-13, there being an appreciable reduction in June, 1911-13. Eggs advanced 1½d. per dozen on the month, and at 52 per cent. above pre-war were relatively dearer than in June last year.

Gooseberries have sold at fairly high prices, averaging during June 81 per cent. above pre-war, and strawberries have averaged 54 per cent. above pre-war.

Cabbage realised 78 per cent. and cauliflowers 76 per cent. above pre-war.

Index numbers of different commodities during recent months and in June, 1923 and 1924, are shown below :—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	1923.	1924.	1925.			
Commodity.	June.	June.	Mar.	April.	May.	June.
Wheat ...	38	42	79	62	59	62
Barley ...	17	48	45	38	36	38
Oats	41	32	38	34	36	38
Fat cattle ...	52	55	51	50	49	50
Fat sheep ...	83	93	97	100	100	93
Bacon pigs ...	62	29	67	68	60	54
Pork " ...	76	33	66	67	60	53
Dairy cows ...	50	59	48	47	48	47
Store cattle ...	31	47	43	39	40	43
Store sheep ...	114	121	104	100	99	115
Store pigs ...	130	32	47	64	55	55
Eggs... ...	40	43	49	51	48	52
Poultry ...	87	93	57	50	55	61
Milk	53	50	82	58	55	55
Butter ...	33	43	58	64	54	57
Cheese ...	44	83	57	61	70	78
Potatoes ...	—31*	174	138	115	124	76
Hay	42	3	—1*	—2*	3	3

* Decrease.

FIELD EXPERIMENTS AT ROTHAMSTED DURING 1923 AND 1924.

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THE field experiments at Rothamsted deal in the main with problems of manuring, though increasing attention is now being paid to cultivations, liming and the growth of leguminous crops, especially lucerne. This preponderance of manuring in the programme is the outcome of the historical development of the Institution, and could be justified by the fact that the farmers of Great Britain make large amounts of farmyard manure and in addition buy great quantities of artificial fertilisers. It is difficult to obtain exact statements of the amounts of money expended, but on the assumption that one ton of straw makes four tons of manure, the value of the farmyard manure may be put roughly at about £14,000,000 per annum, while the amount spent on artificial manures is probably not much short of £8,000,000 per annum. Pending more accurate data, these figures indicate the importance of the problems, and they show how much the farming community may lose each year through even small wastes and losses of efficiency.

Nature of Action of Fertilisers.—It might be supposed that little remains to be learnt about fertilisers after all the experiments made in various parts of the country for the last 30 years. No one who has seriously studied the subject would admit this. The preference shown by farmers for compound fertilisers made up to a manufacturer's specification and not to their own shows that as a rule they mistrust their knowledge of fertilisers, while the keen interest always shown in the Rothamsted plots and in the Rothamsted lectures on the subject proves the great need for the work.

The farmer's purpose in using manures is to obtain larger and better crops, but experience shows that the manures have two distinct effects on the crop:—

(1) They increase the amount of plant growth.
(2) They alter the habit of growth or the character of the plant.

In consequence of this double action a crop increased by any fertiliser is not, so to speak, a photographic enlargement of an unmanured crop; there is always a distortion. The following experiment illustrates this point; swedes were grown without manure; with phosphates and potash but no nitrogen; and with phosphates, potash and nitrogen. Each crop was larger than the unmanured, but each was a distorted enlarge-

ment. The phosphates and potash enlarged the root more than the leaf; the nitrogen on the other hand enlarged the leaf more than the root. The figures are :—

WEIGHTS: TONS PER ACRE.

	No Manure	Phosphates and Potash* No Nitrogen	Nitrogen with Phosphates and Potash
Root	24.0	25.7	27.7
Leaf	2.94	2.91	3.58

PROPORTION OF LEAF TO 1,000 OF ROOT.

	No Manure	Phosphates and Potash* No Nitrogen	Nitrogen with Phosphates and Potash
Root	1,000	1,000	1,000
Leaf	121	112	129

Sometimes the distortion is not evident to the eye, though it is readily revealed by chemical analysis and shows itself in some "quality" character which may be important to the farmer or to the buyer. Potassic fertilisers increase the yield of potatoes but do not necessarily change their appearance. The potatoes grown in 1922 were carefully judged by one of the most experienced buyers in the London market; the samples were numbered, but no hint was given as to their manurial treatment. His marks showed very little connection with the fertiliser treatment; they were as follows :—

MANURIAL TREATMENT OF POTATOES.

Highest price :	Farmyard manure and muriate : farmyard manure and kainit : unmanured : French kainit.
Lower price :	Sulphate of potash : German kainit : potassium and magnesium sulphate.
Still lower :	Farmyard manure and sulphate of potash.
Lowest price :	Nitrogen and phosphate but no potash.

Analysis showed, however, consistent differences in chemical composition of the tubers manured in the various ways which would affect the feeding value and other properties included in "quality"; the figures are :—

PERCENTAGE OF STARCH IN DRY MATTER OF POTATOES.

No Potash	Potassic fertilisers		
	Sulphate	Muriate	Kainit
57.2	65.8	64.0	58.2

These distortions are also important in influencing the variations in fertiliser action in different seasons. It is common knowledge that the effectiveness of fertilisers varies with the weather conditions. This is not because of any erratic element in the

action of fertilisers; it is simply that the changes they produce in the growth of the plant may be important in one season, but not in another. The 1922 experiments with basic slag on swedes showed this well. The swedes without slag were late in starting, later even than those without manure; they were later in being ready for hoeing, and they ripened later. In some seasons this would have made an important difference to the crop. 1922 was, however, so good a season for swedes that the final advantage of using slag was only small and did not repay the cost of the slag. The yields were :—

No slag	... ...	28.1 tons per acre.
Slag.	Low grade, high soluble	29.0 ,, ,, ,,
	High grade, high soluble ...	30.4 ,, ,, ,,

A further illustration is afforded by the action of phosphates on barley. Addition of phosphates is followed by increased root development and increased tillering, and later on an earlier maturation as shown by the barley plants taken from the classical Hoos field at Rothamsted. The advantages of obtaining plants like those receiving phosphates as against those receiving none are many, quite apart from the obvious agricultural advantages. The gout fly does considerable damage each year to the barley crop; it lays its eggs near the top of the uppermost leaf, the larvæ crawl downwards and enter the young unformed ear if it is still ensheathed in its leaves, as in the case of the plants grown without phosphate; the larvæ then proceed to feed upon the ear and do much damage. If, however, the ear has shot out, as has happened where phosphate was given, the larvæ are unable to find it, and they continue crawling down till they reach the soil, where they perish. On Hoos field these effects are intensified by the long continued growth of one crop receiving always the same manurial treatment, but in many farming conditions they are produced to a greater or smaller degree; sometimes they are valuable and in other conditions they are not. The Rothamsted and the Woburn data illustrate these effects. The actual figures are :—

YIELD OF BARLEY GROWN IN ROTATION : MEASURED BUSHELS PER ACRE.

	Rothamsted			Woburn		
	1922	1923	1924	1922	1923	1924
Complete Manure ...	36.0	32.5	29.8	44.7	43.4	29.4
No Phosphate	36.8	34.4	30.6	39.9	38.8	38.8

In 1922 and 1923 the phosphate effect was valuable at Woburn, adding nearly 5 bushels per acre to the yield; in 1924 the phosphate was apparently harmful. At Rothamsted the effect was in no year important.

These results show that one must look always for two kinds of fertiliser action—increase in growth and change in habit. The latter may on some soils and in some seasons add to the certainty of the crop, enhance its value, give it a better chance of escaping insect or other pests or diseases; or have other effects of agricultural importance.

We can now turn to a consideration of the various crop results.

The Effect of Fertilisers on Cereals.—It is a commonplace that the yield of cereals can be increased by the use of nitrogenous fertilisers, but it is rather surprising that the increase should be so regular from season to season. For the past three years the gains from the use of 1 cwt. of sulphate of ammonia per acre have been:—

GAINS IN BUSHELS PER ACRE.

	1922 Rothamsted	1923 Rothamsted	1924 Rothamsted	1924 Outside Centres	Average of all soils and seasons to 1920
Wheat ...	3.25	—	—	4.3-6	4.5
Barley ...	5.5	4.5	8.25	3.5	6.5
Oats ..	—	8.3	—	—	7

These increases correspond to a recovery of about 35 or 40 per cent. of the nitrogen of the fertiliser.

A number of experiments have been tried to ascertain how far it is worth while increasing the dressing of nitrogenous manure. The earlier experiments at Rothamsted were made on wheat dressed with large amounts of ammonium salts in addition to substantial dressings of superphosphate and potassic and other salts; the increase in yield obtained by successively increasing the dressing of ammonium salts became less and less and finally

ceased to pay for the cost of the manure. This experiment was carried on from 1852-1864: it illustrates the incontrovertible law of diminishing returns, and always proves of absorbing interest to the agricultural economist. The figures were:—

Manures per acre	Dressed Grain—bushels		Straw—cwt.	
	Produce per acre	Increase for each additional 200 lb. N. in manure	Produce per acre	Increase for each additional 200 lb N. in manure
Minerals alone	18.3	—	16.6	—
,, + 200 lb. ammonium salts	28.6	10.3	27.1	10.5
,, + 400 lb. ,, ,,	37.1	8.5	38.1	11.0
,, + 600 lb. ,, ,,	39.0	1.9	42.7	4.6
,, + 800 lb. ,, ,,	39.5	0.5	46.6	3.9

All plots received a dressing of 3½ cwt. superphosphate, 200 lb. sulphate of potash, 100 lb. sulphate of soda and 100 lb. sulphate of magnesia, in addition to the ammonium salts. Clearly there is no advantage in giving dressings exceeding 400 lb. of ammonium salts per acre. But it is equally clear that the figures afford no guidance in present day conditions. It is of no practical importance to discuss whether one could justifiably increase manurial applications to wheat from 400 lb. ammonium salts and 800 lb. of other fertilising salts—nearly 11 cwt. of fertiliser in all—to 800 lb. ammonium salts and 800 lb. of other fertilisers, since no one would use anything like these quantities in practice. The experiment is of great value in other directions, but it affords no guidance to the farmer uncertain whether to use ½ cwt., 1 cwt. or 2 cwt. sulphate of ammonia per acre as a top dressing.

In the more recent experiments, the effect of 1 cwt. sulphate of ammonia is compared with that of 2 cwt. per acre. In four out of six years, the increment of gain has been greater for the second cwt. than for the first; in other years the wheat crops were poor and the results uncertain, while the barley of 1922 did not exceed 33.3 bushels per acre. The figures in bushels per acre are:—

EFFECT OF SULPHATE OF AMMONIA IN INCREASING THE YIELD OF CEREALS.

	* Crop.	No Nitrogen	1 cwt. sulphate of ammonia	2 cwt. sulphate of ammonia	Increase in yield for 1st cwt.	Increase in yield for 2nd cwt.
1920	Wheat ...	28.9	28.7	35.9	Nil	7.2
1921	Wheat ...	17.5	18.1	17.9	Nil	Nil
1922	Wheat ...	13.4	17.1	19.8	3.7	2.7
	Barley ...	25.2	32.3	33.3	7.1	1.0
1923	Oats ...	29.2	37.3	46.5	8.1	9.2
	Straw (cwt.)	19	26	36	7	10
1924	Barley ...	23.9	32.5	42.7	8.6	10.2

The straw of the 1920 wheat and of the 1923 oats, like that of the grain, showed greater increases for the second dose of sulphate of ammonia than for the first, but the barley straw did not: nor did the total produce. The oat results for 1923 are given in the table above: the barley figures were :—

* Crop.	Straw, cwt. per acre	Gain for 1 cwt. sulphate of ammonia	Total produce lb. per acre	Gain for 1 cwt. sulphate of ammonia
No Manure	14.0	—	2,987	—
Basal manure only ...	14.1	—	3,010	—
Basal + 1 cwt. sulphate of ammonia	19.7	5.6	4,188	1,178
Basal + 2 cwt. sulphate of ammonia	24.7	5.0	5,285	1,097

Physiological investigations are being undertaken to find out the principles underlying these results. So far as the evidence goes it appears that 2 cwt. of sulphate of ammonia (and there seems no reason why nitrate of soda should behave differently, though the experiment has not been made) gives in good seasons more than double the increased yield of corn obtained from 1 cwt., but in bad seasons the full increase is not obtained. It is not suggested that 4 cwt. of the fertiliser would give more than twice the increase given by 2 cwt., for the law of diminishing returns inevitably begins to operate somewhere; but it seems clear that a series of increasing returns precedes the setting in of the diminishing return.

This experiment is being continued, and it might advantageously be repeated at other centres. The wide-spread use of stiff-strawed varieties of cereals renders possible more

* The varieties were:—Wheat, Red Standard; Oats, Grey Winter; Barley, Plumage Archer.

manuring than could formerly be justified, and since the manuring is in any case only a minor item in the cost of growing cereals, it can more safely be increased than could a more expensive item.

Investigations have been begun to study the effect of altering the time of application of the fertiliser. The late application of the larger dressing of sulphate of ammonia has been more effective than the early application in increasing the yield of grain, but not in increasing the yield of straw. Thus in 1924 the yields of oats were :—

YIELD OF OATS, BUSHELS PER ACRE.

	No Nitrogen	1 cwt. sulphate of ammonia	2 cwt. sulphate of ammonia	Gain for 1 cwt. sulphate of ammonia		Total gain for 2 cwt. sulphate of ammonia
				1st dose	2nd dose	
——	29.2	—	—	—	—	—
Early application ...	—	37.3	46.5	8.1	9.2	17.3
Mid-season	—	37.7	45.4	8.5	7.7	16.2
Late application ...	—	34.6	53.7	5.4	19.1	24.5

The dates of applying the dressings were :—

1. Applied early (March 28th).
2. Applied mid-season (April 22nd).
3. Applied late (May 22nd).

The increment in yield of straw, like that of grain, is greater for the second dose of sulphate of ammonia than the first, but it is not greater for the late season applications than for the early dressings :—

YIELD OF OAT STRAW, HUNDREDWEIGHTS PER ACRE.

	No Nitrogen	1 cwt. sulphate of ammonia	2 cwt. sulphate of ammonia	Gain for 1 cwt. sulphate of ammonia.		Total gain for 2 cwt. sulphate of ammonia
				1st dose	2nd dose	
——	19	—	—	—	—	—
Early application ...	—	26	36	7	10	17
Mid-season	—	27	32	8	5	13
Late application ...	—	23	34	4	11	15

Indications of a similar action were obtained with the wheat in 1921, but no great importance attaches to the results owing to the lowness of the yields. The experiment is now being followed up.

Use of Ammonium Chloride.—The experiments described above were made with sulphate of ammonia, a fertiliser produced in large quantities in this country as a by-product from coal at gasworks, coking ovens and other works. Since the war there has been available another ammonium salt, the chloride or muriate, also made in this country, but direct from the nitrogen of the air. It is understood that the muriate could be supplied more cheaply than the sulphate. For the past four years field experiments have been made at Rothamsted and at various outside centres to study the behaviour of the two compounds, the comparison being on the basis of equal amounts of nitrogen supplied per acre. The usual result at Rothamsted, Woburn and elsewhere in the corn-growing centres has been for the muriate to give the better results for cereals; when the yields from 1 cwt. sulphate of ammonia are put at 100, the yields from the equivalent quantity of muriate have been for corn crops at Rothamsted:—1921, 106; 1922, 103; 1923, 109; 1924, 104.

The effect of the muriate is somewhat more marked on the grain than on the straw, suggesting that the chloride brings about a greater translocation of material from the leaf and stem to the grain than the sulphate is able to effect. A double dressing of the muriate further increased the yield, and indeed gave the highest values obtained at Rothamsted. The results for barley in 1924 at Rothamsted were:—

GRAIN, BUSHELS PER ACRE.

	Sulphate of Ammonia		Chloride of Ammonia		Ratio of yield Chloride: Sulphate
	Yield	Increment due to dose of N.	Yield	Increment due to dose of N.	
No Nitrogen.	23.9	—	23.9	—	—
Single dose Nitrogen	32.5	8.6	34.8	10.9	107 : 100
Double dose Nitrogen	42.7	10.2	45.3	10.5	106 : 100

Support is given to this view by the chemical examination of the grain; the percentage of nitrogen is diminished by the chloride as compared with the sulphate, indicating a greater piling up of non-nitrogenous or of carbohydrate material.

The figures are:—

NITROGEN PER CENT. IN BARLEY GRAIN

	1922	1923	1924
Sulphate of ammonia	1.647	1.544	1.517
Ammonium chloride	1.602	1.485	1.495

The Quality of the Crop.—So far only the effect on yield has been considered; there is, however, the very important question whether the quality of the crop has suffered or the straw has become weakened by the nitrogenous top dressings. No evidence of any harmful effect was obtained. Present day varieties of corn crops stand up well, and there has been no trouble about lodging. The question of quality in barley is being studied at some length, quality being to the farmer more important for this than any other corn crop under present conditions. The experiments were made at Rothamsted and on certain good barley farms in various parts of the country, the work being done in connection with the research scheme of the Institute of Brewing. The variety grown is Plumage Archer, and seed from the same field was used at all the centres.

The results show a considerable degree of concordance among themselves, but they differ in several important respects from the current teachings of agricultural science. It is usually recommended that the manuring for barley should be mainly phosphatic, nitrogen being given only in special circumstances and potash but rarely. Out of 30 different tests, this recommendation would have involved loss of money in no less than 26; the average reduction in yield caused by the omission of each fertiliser during the three years, 1922, 1923 and 1924, being in bushels per acre:—

Decrease due to omission of:—	After a straw crop	After roots fed off	After potatoes or beets (well manured)	Mean of all experiments
1 cwt. sulphate of ammonia	5.8	3.9	6.7	5.4
3 cwt. superphosphate ...	0.9	(0.5)	1.2	0.5
1½ cwt. sulphate of potash	(1.1)	1.3	1.1	0 3

(The figures in brackets are increases and not decreases)

The reasons for this unexpected result are probably two:—

1. The modern varieties of high quality barley, such as Plumage Archer, are stiffer in the straw than the older ones, and therefore can carry larger crops of grain without danger of being lodged. Apparently, therefore, they can safely receive more nitrogenous manuring.

2. Good farmers now realise the importance of giving ample dressings of superphosphate to their root crops, and sufficient

of this fertiliser generally remains in the soil to satisfy the needs of the barley. Potash and phosphates intended for the seeds mixture can, of course, be applied to the barley in which they are sown. The barley may derive benefit, but the profit, if any, must come from the seeds.

One of the distinguishing features of the scheme is that all the experimental barleys are examined by expert maltsters appointed by the Research Committee of the Institute of Brewing, and are afterwards malted separately and the malts fully analysed.

It is shown that the use of a nitrogenous manure, even after roots folded off, has not adversely affected the valuation of the barley or the value of the malt, but that the omission of potash from the manure lowered some of the desirable qualities of the malt in 1922, though not apparently in 1923. At each centre the heaviest crops obtainable by manuring have been valued as high, or nearly as high, per quarter, as any other samples of the same set, and it is clear that manurial schemes can be devised which will enhance the present yield without detriment to valuation. So far as the investigation has gone, it suggests that farmers using a good modern variety of barley can aim at the biggest crop that will stand, and they can use the appropriate fertiliser to secure this without fear of loss of valuation. Thus, for the season 1923 the figures for valuation per quarter of 448 lb. made in January, 1924, were:—

	Rothamsted	East Lothian	Eyton	Chiselborough	Walcott	Warminster	Lincs Wolds
1 cwt. sulphate of ammonia	57/-	49/6	49/-	47/-	41/6	52/-	42/-
No nitrogen	56/-	49/-	50/-	46/-	41/-	52/-	41/6

It has already been stated that the nitrogen content of the grain is lowered when the muriate of ammonia is used as a fertiliser instead of the sulphate. Although the valuers did not know this—nor indeed did they know anything of the manurial treatment of the samples before them—they had no hesitation in placing the higher valuation per quarter of 448 lb. on the barley that had received the muriate. When yield and valuation are taken together and reckoned in terms of money value per acre, and when tail corn is allowed for, there comes out an important difference in favour of the muriate:—

	Valuation of Barley per quarter of 448 lb.		Money Value per acre		Difference per acre in favour of chloride as against sulphate
	Ammonium Sulphate	Ammonium Chloride	Ammonium Sulphate	Ammonium Chloride	
1922	31/-	36/-	136/-	156/-	20/-
1923	57/-	58/-	239/-	265/-	26/-
1924	63/-	64/-	238/-	249/-	11/-

In the course of the work it has become clear that the method of valuation commonly adopted does not always work out quite fairly either to the buyer or to the farmer. On the loams the estimate has usually come out tolerably correctly; the value of the malt has paid the cost of the barley, the transport expenses, and profits of malting and other charges. But on the lighter soils the barley has not generally been as good as it looked, so that the value of the resulting malt did not pay all the charges. On the chalk and limestone soils the barley turned out better than it looked; the farmer received less than he deserved and the malt gave an additional profit to the maltster.

These results are quite intelligible. The buyer judges from external appearances of the barley which are on the whole correlated with the value of the resulting malt. But the correlations between the external characteristics and chemical composition are liable to be affected by changes in environment, and it need occasion no surprise that a correlation holding good on loams may be modified in one direction on a sandy soil, and in another on a chalk soil.

The malting and brewing part of the investigation lies outside the scope of Rothamsted, and is carried out entirely by the Institute of Brewing, but the Station, at the cordial invitation of the Institute, is keeping in close touch with the work.

A curious fertiliser effect which is being followed up is the occasional injury to yield which seems to follow the application of potash or of phosphates. The effect is not always obtained, even at the same centre: Woburn, in 1924, afforded an example of apparent injury of phosphate to barley; Wellingore shows an apparent injury of potassic fertilisers in 1922 and 1924, two years out of three in which the experiment was tried; and Rothamsted showed apparent injury in 1924.

BARLEY: BUSHELS PER ACRE
WELLINGORE.

	1922		1923		1924		Rothamsted 1924	
	Yield	Difference from complete fertiliser	Yield	Difference from complete fertiliser	Yield	Difference from complete fertiliser	Yield	Difference from complete fertiliser
Complete fertiliser	39.0		45.8		50.7		29.8	
No potash ...	43.5	+4.5	43.8	−2.0	58.2	+7.5	34.4	+4.6
No phosphate	40.5	+1.5	46.4	Nil	49.9	Nil	30.7	Nil
No nitrogen	37.3	−1.7	39.2	6.6	45.2	−5.5	22.0	−7.8
No manure	36.1	−2.9	40.8	−5.0	43.8	−6.9	25.8	−4.0

Effect of Fertilisers applied to Cereals on Clover Crops sown in them.—Fertilisers applied to cereals may affect clover sown in them, and any injury done must be set off against the gains.

The experiments show that potassic fertilisers applied to barley at Rothamsted exert a distinctly beneficial effect on the clover in the following year, giving an additional 12 cwt. of clover hay in 1923 (barley of 1922), and 6 cwt. in 1924 (barley of 1923). Sulphate of ammonia applied to the barley also appeared to benefit the clover; we do not understand this result, and it is being further studied. The Rothamsted soil contains sufficient calcium carbonate to prevent any possibility of acidity: otherwise the clover is liable to be injured. Phosphates on our soil produce no residual effect on the clover. The results have been:—

Year in which clover was sown	No Nitrogen	Yield of clover in following year, after fertiliser applied to barley. Cwt. per acre.)				
		Sulphate of Ammonia	Muriate of Ammonia	No Potash	Sulphate of Potash	Muriate of Potash
1921		All clover failed				
1922	31.0	35.1	37.1	23.7	36.8	39.1
1923	61.5	72.3	63.6	23.7	36.1	39.1
1924		Crop still growing				

The Manuring of Potatoes.—Two extensive series of experiments have been carried out with potatoes: the effect of nitrogenous manure (chiefly sulphate of ammonia) and the effect of various potassic fertilisers.

On an average, the addition of 1 cwt. sulphate of ammonia per acre has increased the yield of potatoes by 20 cwt. per acre. Second and third doses of sulphate of ammonia give further increases, but not usually as much as did the first: for with this crop, unlike the cereals, the increment of the return generally falls off from the beginning, though the higher dressing still remains profitable because of the higher value of the potato crop.

The yields, in tons per acre, have been as follows :—

	No Nitrogen	1½ cwt Ammonium Sulphate	3 cwt Ammonium Sulphate	4½ cwt Ammonium Sulphate	Increment in yield for 1st dose	2nd dose	3rd dose
1922	6.07	7.99	9.73	10.08	1.92	1.74	0.35 (1)
	5.50	7.37	8.97	8.98	1.87	1.60	Nil (2)
1923	12.0	13.7	15.1	14.8	1.7	1.4	Nil
1924	8.0	9.5	9.4	—	1.5	Nil	—

(1) with 15 tons farmyard manure. (2) No farmyard manure.

The effect of the nitrogenous dressing depends on the time of application. In all our experiments it has proved better to apply the sulphate of ammonia with the seed rather than to give it later as a top dressing when the plants are showing through the ground. The yields of potatoes in tons per acre in 1923 and 1924 have been :—

		All ammonium sulphate given with seed.	½ ammonium sulphate given with seed, ½ as top dressing.
1923	Basal manure alone ...	12.0	—
	,, ,, + 3 cwt. Sulphate of Ammonia	15.7	15.25
1924	Basal manure alone ...	8.03	—
	,, ,, + 3 cwt. Sulphate of Ammonia	9.41	9.16

Ammonium chloride, or muriate, has been generally less effective for potatoes than ammonium sulphate, but the difference depends very much on the rainfall. In dry conditions, chloride is distinctly inferior: in wet conditions the difference becomes less, and finally disappears. Thus, in 1923, when the rainfall during March, April and May was 5.64 in., the chloride had only 92 per cent. of the efficiency of the sulphate, while in 1924, when the rainfall was much higher (8.95 in.), the two fertilisers were equally efficient :—

YIELD OF POTATOES: TONS PER ACRE.

	1923	1924
Using ammonium sulphate	15.12	9.41
chloride	13.94	9.38
Difference in favour of sulphate	1.18	Nil
Rainfall: March, April, May	5.64 in.	8.95 in.

The other series of experiments has been made to study the effect of the various potassic fertilisers. Although the Rothamsted soil is heavy, and naturally well supplied with potash, the potato crop nevertheless responds to potassic fertilisers, even when dung is supplied in addition. The gains in tons per acre from sulphate of potash have been :—

	1921	1922	1923	1924
Dung and 1½ cwt. sulphate of potash ...	0.31	1.52	0.79	Nil
No dung; 2 cwt. sulphate of potash ...	2.41	5.83	2.53	1.08

It is interesting to contrast these with the gains from 1 cwt. sulphate of ammonia, in tons per acre :—

	1921	1922	1923	1924
Dung	—	1.28	1.02	—
No dung	0.15	1.24	1.74	0.97

Certain qualitative effects of the potassic fertiliser are always shown. These were particularly striking in 1921, the worst year we have had, when the potatoes without potash died early in the season, while those with potash were still growing. In 1923, the record year for good yields, growth was not as rapid on the "no potash" plot, even in the presence of dung, as it was where potash was supplied, and although later on there seemed to be the same amount of growth, the leaves of the "no potash" plot were dull and dark green. Towards the end of August the plants without potash developed leaf-curl, and by the end of September a large proportion were dead. These appearances were intensified on the plots receiving no dung.

As between the various potassic fertilisers, the muriate and the sulphate of potash have been nearly, but not quite, alike in their effect, the muriate giving sometimes a slightly better and sometimes a slightly lower yield than the sulphate. The determining factor is partly rainfall, the sulphate tending to give the higher yield in drier conditions and the muriate in wetter, but there is something besides this, for in 1924 the sulphate came out the better in spite of the wetness of the season.

Sodium chloride given in addition to the muriate of potash, is injurious; neither kainit nor sylvinite yielded the full benefit expected from the potash because of the harmful effects of the salt. This is to some extent mitigated by additions of dung, but the crop always falls below that obtainable from the muriate or the sulphate of potash. The average of the results at Rothamsted and at outside centres inspected by our Staff is :—

YIELD OF POTATOES WHEN THAT FROM SULPHATE OF POTASH = 100

	1922		1923		1924
	Without dung	With dung	Without dung	With dung	With dung
Muriate of potash ...	102	99	104	105	95
Sylvinite	85	93	91	100	87

The effect of these fertilisers on the quality is being studied in detail. Of the complete manured plots, those receiving sulphate of potash produce tubers with the highest percentage of dry matter :—

Potassic Fertiliser Used	Percentage dry matter of potato tubers grown at				
	Rothamsted		Rease-heath	Seale-Hayne	Usk
	1922	1923	1922	1922	1923
Sulphate ...	24.26	21.73	21.68	24.4	23.6
Chloride ...	22.02	20.85	21.63	22.3	22.5
Low grade salts	19.68	17.87	17.28	22.7	21.0
No potash ...	23.07	20.65	17.62	25.7	22.1

The tubers grown with low grade potash salts (kainit, sylvinite) are the lowest in dry matter content, coming out even below those grown without potash.

The percentage of starch in the dry matter is an important quality factor, and in all tubers so far analysed, the value comes out higher for the sulphate of potash than for any of the other salts.

PERCENTAGE OF STARCH.

	Yield in tons per acre	Dry matter per cent. in tubers	Starch per cent. in dry matter	Starch
Sulphate ...	8.30	24.26	68.84	1.325
Chloride ..	8.32	22.02	64.00	1.175
Low grade salts	8.06	19.68	58.20	0.925
No potash ...	2.47	23.07	57.16	0.325
Control ...	2.98	23.36	58.20	0.405

These differences in density and composition are not clearly indicated by any external character, and, as already stated, an expert buyer in the London market failed to discriminate clearly between the potatoes grown with potassium sulphate and those grown with the muriate or even kainit. A cooking test made by courtesy of Messrs. Lyons by one of their expert chefs gave a more definite result, the order of merit being :—(1) Sulphate of

potash; (2) Muriate of potash; (3) Muriate of potash and salt—No potash.

Another cooking test made by a good amateur agreed in placing first on the list the potatoes which had received sulphate: the order was:—(1) Sulphate of potash; (2) Muriate of potash and salt; (3) No potash; (4) Muriate of potash.

Mr. Eden has devised a simple test based on the specific gravity differences which promises to be useful in rapidly assessing quality. The potatoes are placed in a salt solution of the proper strength: the potatoes of high dry matter and starch content sink while those of lower quality float.

One would not expect to find any close relationship between the behaviour of cereals and of potatoes towards fertilisers. But it repeatedly happens that the potatoes behave in exactly the opposite way to the cereals. This is most easily shown as follows:—

	Corn.	*Potatoes.*
Effect of second and subsequent doses of sulphate of ammonia.	Often increased increment of yield.	Always decreased increment of yield.
Effect of time of application of sulphate of ammonia.	Late application sometimes best.	Early application always best.
Effect of muriate of ammonia compared with sulphate of ammonia.	Muriate gives better yield, especially in dry conditions.	Muriate not so good yield, especially in dry conditions.
	Muriate gives better quality.	Muriate not so good for quality.

The contrast shows very clearly when one brings together the results for muriate and sulphate of ammonia:—

VALUE FOR EFFECTIVENESS OF MURIATE OF AMMONIA WHEN SULPHATE = 100.

Year	1921	1922	1923	1924
Yield of Corn	106	103	109	104
Nitrogen in Grain of Barley	—	97.3	96.2	98.4
Yield of Potatoes	(112)*	95	92	100
Rainfall (Mar., Apr., May)	4.08	7.38	5.64	8.95

* Crop almost failed: 2 tons per acre only.

These curious effects present to laboratory investigators a number of interesting problems which are being further studied.

YIELDS OF POTATOES WITH VARIOUS POTASSIC FERTILISERS: TONS PER ACRE.

	1921		1222		1923			
					Rothamsted		Outside centres	
	Dung	No Dung	Dung	No Dung	Dung	No Dung	Dung	No Dung
Complete artificials ...	3.94	3.76	9.55	8.30	12.45	12.25	10.04	9.40
No potash	3.63	1.35	8.03	2.47	11.66	9.72	8.83	6.85
No artificials ...	3.33	1.54	—	2.98	10.48	7.95	7.22	5.90
Sylvinite ...	—	—	—	7.73	10.48	10.61	9.83	8.60
Gain from complete artificials	0.61	2.22	—	5.32	1.97	4.30	2.82	3.50
Gain from sulphate of potash	0.31	2.41	1.52	5.83	0.79	2.53	1.21	2.55

THE INFLUENCE OF ROOTS AND OTHER FEEDING STUFFS ON MILK PRODUCTION.

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THE practice of rationing dairy cows according to their milk yield has, during recent years, been a factor of very considerable importance in controlling the cost of producing milk. Sufficient records now exist from which conclusions can be drawn which should be of interest and possibly guidance to a number of farmers engaged in the production of milk.

During the past five years returns have been systematically collected by the Milk Recorders of the East Sussex Milk Recording Society and these now form a record containing a considerable amount of useful information.

It is common knowledge that great differences of opinion exist not only amongst farmers, but also amongst agricultural investigators concerning the effects of different feeding stuffs. Many of these opinions so firmly held by farmers are diametrically opposed to each other and in a number of cases are undoubtedly erroneous, being based on either individual experience or on too small a number of examples to have any general value. A farmer frequently attributes an increase or a decrease in his milk yield to some factor quite different from the real cause, and it is because of these differences of opinion amongst farmers and others that the conclusions drawn from the records collected should have economic value.

Method of Examination of Records.—In all 1,665 different records of herds have been examined and these relate to 35,248

rations fed to cows under varying circumstances. Each group of 100 herds contains on the average approximately 2,000 cows. The herds have been recorded weekly and the results checked by the recorders of the East Sussex Milk Recording Society. It may be contended that other factors than those connected with the feeding would influence the yield. This is admittedly so, but these differences would tend to disappear when such a large number is considered. For example, it might be argued that low yields are in many cases due to an advanced lactation period. In certain individual cases of cows, not of herds, this may be so, but generally the herds are essentially winter milk-producing herds. Practically all the cows in the groups referred to would calve in or near October, whilst the records commence in November and are continued until about the middle of March, so that the question of low yields being due to advanced lactation periods does not arise.

Again, it might be contended that larger quantities of roots have been fed to the cows giving the greatest quantity of milk and not that the higher milk yield is due to the larger quantity of roots. This, generally, is not so in the herds concerned as it is the usual practice to feed the herds uniformly with roots and the quantity of roots is not varied according to the individual yield of the cow but depends on the amount of roots available during the winter months. Thus, after a drought, when roots are scarce, the quantity fed is naturally considerably smaller than in normal years.

A further contention might be that the low yields are due to insufficient feeding, but generally it has been found that, if anything, the tendency has been that the low-yielding herd is usually overfed, and the high-yielding herd underfed.

The Effect of Feeding Roots on the Milk Yield.—In East Sussex the general opinion of dairy farmers is that roots play a very marked part in increasing the yield of milk when other factors are constant. On the other hand, there are a number of farmers who are strongly opposed to growing roots for milk production and are convinced that they can be replaced more economically by concentrated feeding stuffs. An examination of the data collected in these records appears to indicate that as far as East Sussex is concerned the quantity of milk rises in direct proportion to the amount of roots fed. As will be noted from the appended figures, the average yields of these herds vary from 1.28 gallons per cow to 3.39 gallons per cow, whilst it will be noted from Table 1 *that there is a proportionate*

increase throughout in the amount of roots fed varying from 15.46 lb. at one extreme to 40.36 lb. at the other. Included in these figures are those herds to which roots were not fed. In individual cases the amount of roots fed far exceeds the average amount, but these wide divergencies disappear when averages of records of 100 herds are considered.

Table 2 shows the results, *excluding* the herds which received no roots. The yield of the different groups of 100 herds here varies from 1.37 gal. to 3.26 gal., and again the increase in yield of milk appears to be in direct proportion to the increase in roots.

Table 1.

ROOTS.

	Average Yield of Milk per Cow. Gal.	Average Amount of Roots fed per Cow. lb.
1st 100 Herds (Lowest)	1.28	15.46
2nd ,, ,,	1.53	24.31
3rd ,, ,,	1.65	24.83
4th ,, ,,	1.76	22.81
5th ,, ,,	1.84	29.77
6th ,, ,,	1.94	27.61
7th ,, ,,	2.00	30.72
8th ,, ,,	2.07	30.90
9th ,, ,,	2.13	30.45
10th ,, ,,	2.20	30.34
11th ,, ,,	2.26	38.75
12th ,, ,,	2.34	33.88
13th ,, ,,	2.43	36.63
14th ,, ,,	2.53	31.27
15th ,, ,,	2.67	37.16
16th ,, ,,	2.91	38.06
17th (65) ,, (Highest)	3.39	40.36

Table 2.

ROOTS

(Excluding all Herds receiving no Roots).

	Average Yield of Milk per Cow. Gal.	Average Amount of Roots fed per Cow. lb
1st 100 Herds (Lowest)	1.37	27.92
2nd ,, ,,	1.61	31.23
3rd ,, ,,	1.74	29.28
4th ,, ,,	1.86	36.66
5th ,, ,,	1.97	33.51
6th ,, ,,	2.03	33.00
7th ,, ,,	2.11	36.03
8th ,, ,,	2.18	38.92
9th ,, ,,	2.26	40.54
10th ,, ,,	2 35	38.41
11th ,, ,,	2.46	41.62
12th ,, ,,	2.57	41.57
13th ,, ,,	2.78	42.22
14th (87) ,, (Highest)	3.26	47.52

Succulent Food including Roots.—Succulent foods, such as marrow-stem kale, thousand-headed kale, rape and cabbage, play a part of considerable importance in connection with milk production in East Sussex, and are to some extent interchangeable with roots. Table 3 shows again the direct relation between the increase of milk produced and the increase of succulent food fed.

Apart from the importance of increased milk yield arising from the use of roots and other succulent food, there are other factors of considerable importance. It is well known that herds of dairy cows fed almost exclusively on wet grains yield large quantities of milk, but that under this system of feeding they do not long stand the strain of heavy milk production, whilst further, it is possible that sterility, which so frequently occurs amongst such herds, may be due to a deficiency of some mineral or other substance from the diet. To milk producers, therefore, it is of no small importance to realise that with the feeding of roots and other succulent crops, not only apparently is the output of milk increased, but still further that such rations help to eliminate risks of mineral or other deficiencies in the food.

If this conclusion concerning roots and other succulent food is correct, it has a wide bearing on agriculture generally, as it is the root crop which secures during the rotation that extra amount of cleaning and tillage which has such a beneficial effect on subsequent corn crops.

Table 3.
ROOTS
(Including Cabbage, Kale and Rape).

	Average Yield of Milk per Cow. Gal.	Average Amount of Roots fed per Cow. lb.
1st 100 Herds (Lowest)	1.28	18.93
2nd ,, ,,	1.53	28.45
3rd ,, ,,	1.65	27.41
4th ,, ,,	1.76	25.97
5th ,, ,,	1.84	33.89
6th ,, ,,	1.94	31.92
7th ,, ,,	2.00	34.72
8th ,, ,,	2.07	35.04
9th ,, ,,	2.13	32.94
10th ,, ,,	2.20	34.39
11th ,, ,,	2.26	41.60
12th ,, ,,	2.34	37.61
13th ,, ,,	2.43	38.85
14th ,, ,,	2.53	39.78
15th ,, ,,	2.67	42.50
16th ,, ,,	2.91	43.97
17th (65) ,, (Highest)	3.39	47.13

The Effect of Hay, Straw and Chaff.—During the past winter farmers have naturally wished to feed as high a proportion of hay as possible to their dairy herds owing to its low market price compared with the price of concentrated food. There is, apparently, a limit to economy in this direction, and it will be seen from the figures collected that hay and similar bulky dry foods are not instrumental in increasing milk yield after a certain limit has been reached, and this limit does not appear to exceed a total of 18 lb. per head per day. As will be seen from Table 4, *there is no relation between the amount of hay fed and the yield of milk produced*, but there is an indication that the hay may even have a depressing effect on milk yield. This is probably due to the fact that too much of the energy value of the diet may be utilised in rendering digestible a ration consisting of a high proportion of bulky dry food, and as has been suggested by certain investigators, the control of the bulk of dry food fed to dairy cattle is a factor of importance if heavy milk yields are desired. It had been observed from the records collected for some years that a high average yield never appeared to be obtained when the amount of hay or straw was higher than about 17 lb. It is probable that on a number of farms not only do the heavier

Table 4.

HAY, STRAW AND CHAFF.

	Average Yield of Milk per Cow. Gal.	Average Amount of Hay, Straw and Chaff fed per Cow. lb.
1st 100 Herds (Lowest)	1.28	17.00
2nd ,, ,,	1.53	17.29
3rd ,, ,,	1.65	16.87
4th ,, ,,	1.76	16.64
5th ,, ,,	1.84	17.09
6th ,, ,,	1.94	17.91
7th ,, ,,	2.00	17.93
8th ,, ,,	2.07	16.44
9th ,, ,,	2.13	18.93
10th ,, ,,	2.20	18.21
11th ,, ,,	2.26	16.76
12th ,, ,,	2.34	18.06
13th ,, ,,	2.43	17.57
14th ,, ,,	2.53	16.52
15th ,, ,,	2.67	17.11
16th ,, ,,	2.91	17.49
17th (65) ,, (Highest)	3.39	16.73

quantities of hay and straw fed produce no beneficial result, but have actually a detrimental effect on the yield of milk.

Concentrated Food.—As might have been expected, the records indicate that common opinion is correct concerning concentrated foods and that milk yields vary in accordance with the

amount of concentrated food fed, but, as will be seen from Table 5, although there is a direct relation between the two, and although the milk yield increases as does the amount of concentrated food, the increase in yield is a greater relative increase than is the increase in amount of the food fed; thus the yield varies from 1.28 to 3.39 gal. or as 1 to 2.6, whereas the concentrated food fed is in the proportion of 1 to 2.0. It seems, therefore, that not only does the milk yield vary with the amount of concentrated food fed, but that the high-yielding herds make better use of the concentrated food than do the low-yielding herds.

Table 5.

CONCENTRATED FOODS.

	Average Yield of Milk per Cow. Gal.	Average amount of Concentrated Foods fed per Cow. lb.
1st 100 Herds (Lowest)	1.28	3.55
2nd ,, ,,	1.53	3.54
3rd ,, ,,	1.65	3.96
4th ,, ,,	1.76	3.88
5th ,, ,,	1.84	4.51
6th ,, ,,	1.94	3.80
7th ,, ,,	2.00	4.09
8th ,, ,,	2.07	4.23
9th ,, ,,	2.13	4.31
10th ,, ,,	2.20	4.47
11th ,, ,,	2.26	4.55
12th ,, ,,	2.34	5.12
13th ,, ,,	2.43	4.75
14th ,, ,,	2.53	5.38
15th ,, ,,	2.67	6.11
16th ,, ,,	2.91	6.27
17th (65) ,, (Highest)	3.39	7.15

Table 6.

AVERAGE NUMBER OF DIFFERENT FOODS FED PER COW.

	Average Yield of Milk per Cow. Gal.	Average No. of Diff. Foods fed per Cow.
1st 100 Herds (Lowest)	1.28	5.24
2nd ,, ,,	1.53	5.81
3rd ,, ,,	1.65	5.85
4th ,, ,,	1.76	6.42
5th ,, ,,	1.84	6.05
6th ,, ,,	1.94	6.53
7th ,, ,,	2.00	6.47
8th ,, ,,	2.07	6.38
9th ,, ,,	2.13	6.87
10th ,, ,,	2.20	6.92
11th ,, ,,	2.26	6.82
12th ,, ,,	2.34	6.78
13th ,, ,,	2.43	7.09
14th ,, ,,	2.53	7.19
15th ,, ,,	2.67	7.16
16th ,, ,,	2.91	7.33
17th (65) ,, (Highest)	3.39	7.24

The Relation between the Number of Feeding Stuffs Used and Milk Yield.—It has, perhaps, not been generally realised that there appears to be a direct relation between milk yield and the *number* of feeding stuffs used, apart from the food contents of the rations. Previously a number of investigators have seemed to conclude that provided a ration contained sufficient starch equivalents and protein, the varieties of feeding stuffs used did not play a part of considerable importance; thus, to take an example; a farmer might feed a ration in accordance with the accepted standards consisting of hay, cotton seed meal and maize meal, whereas another farmer might have adopted similar standards as far as the amounts of starch equivalents and protein were concerned, and have a ration consisting of hay, oat straw, kale, roots, soya bean meal, dried grains and maize gluten. Other things being equal, it seems certain that the farmer feeding the varied ration will obtain better results than the former. This had seemed apparent from the records for some considerable time, but it was scarcely anticipated that the conclusion would have been so well substantiated as it appears to be from Table 6, column 8. The figures given are the averages of the records of 100 herds in each case and cannot, therefore, be given in whole numbers, but it is seen that as the milk yield increases, so does the *number* of different feeding stuffs used.

The Conclusions which the writer has drawn from examination of the records, and his observations of the records and herds during the past five years are as follows, other things being equal:—

(1) That balanced rations containing the required standards of starch equivalents and digestible protein are enhanced in value if the constituents of the ration consist of several different kinds of feeding stuffs.

(2) That the milk yield in East Sussex increases in direct proportion to the amounts of roots and other succulent foods fed up to about 45 lb. per head per day.

(3) That hay and straw and similar bulky dry food above a limit of 17 lb. have no influence in increasing milk yield, but may actually have a depressing effect on the output.

(4) That the milk yield is in proportion to the amount of concentrated food used up to at least 7¼ lb. per head per day, but that there is a greater rate of increase in the yield of milk than in the increase of concentrated food fed.

Although it cannot be claimed that these conclusions are proved by records examined (owing to the presence of different

variables, the data should be submitted to a statistical analysis), the records at least indicate the practice of those who succeed in securing the best results.

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EARLY AGRICULTURAL LITERATURE.

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FOR the beginnings of English agricultural literature we must go back to the middle of the thirteenth century. About 1260 there appeared a little handful of agricultural treatises of which the best known is that of Walter of Henley.

The Middle Ages.—The agricultural industry of that time was of a self-sufficing character and in its organisation differed materially from present conditions. The arable land of the mediæval village was arranged in two or three blocks, each block being divided into a considerable number of strips varying from an acre to half an acre in extent. All the farmers of the village, from the Lord of the Manor down to the Cottar with his small holding of seven or eight acres, had their land distributed in scattered strips in these "open-fields." The large landowner possessed shares in the land of a number of village communities, and upon these shares he grew the corn and fed the cattle that were necessary to maintain his household during the year. The villagers also maintained themselves out of the strips they cultivated, paying an insignificant money rent and performing labour services upon the landlord's strips as the main form of rent payment. The rotation, which was rigid, was based upon either a two or three years' course—corn, pulse crops and fallow. The farmer and his family were almost independent of outside economic activities, making their clothing, household utensils, etc., and only acquiring by purchase or barter the two commodities not susceptible of home production, iron and salt.

Agriculture as practised in mediæval times was entirely traditional and varied but slightly in its general practice in the different parts of the country. There was therefore little demand for an agricultural literature, and the explanation of the appearance of these thirteenth century works is to be looked for in the increasing need of the landowning classes for money. The cost of living was rising and taxation was changing from a system based upon services and payments in kind to one based upon money. The landowners therefore were finding it

imperative to exploit the money-making possibilities of their estates, and hence a demand for books which would tell them how to farm profitably. Books to be circulated in those days had either to be passed from hand to hand or laboriously copied out by the pen. It is not to be supposed, therefore, that their influence was at all great. Two extracts from Walter of Henley will show that few ideas are really modern. He works out a cost account for wheat as follows: "You know surely that an acre sown with wheat takes three ploughings, except lands which are sown yearly; and that, one with the other, each ploughing is worth sixpence, and harrowing a penny, and on the acre it is necessary to sow at least two bushels. Now two bushels at Michaelmas are worth at least twelvepence, and weeding a halfpenny and reaping fivepence, and carrying in August a penny, the straw will pay for the threshing. At three times your sowing you ought to have six bushels, worth three shillings, and the cost amounts to three shillings and three halfpence, and the ground is yours and not reckoned."

This is followed by directions for carrying out an experiment in the yield of wheat seed as between that produced on the farm and imported seed.

"Change your seed every year at Michaelmas," he tells us, "for seed grown on other ground will bring more profit than that which is sown on your own. Will you see this? Plough two selions at the same time, and sow the one with seed which is bought and the other with corn which you have grown: in August you will see that I speak truly."

Sixteenth Century.—The agricultural community was dependent on Walter of Henley's treatise for three centuries. That it was fairly widely read is indicated by the number of copies still in existence. Miss Lamond, in her edition of Walter of Henley published for the Royal Horticultural Society, notices twenty-one copies in various libraries. This total may not seem large, but literature of this character, owing to the very fact of its practical utility, was specially liable to destruction. In the interval between the appearance of Walter of Henley's works and Fitzherbert's "Husbandry," which is the next on the list of agricultural publications, considerable changes took place in the organisation of English agriculture. The landlord, finding farming with bailiffs and compulsory labour an unprofitable operation, began to let farms to tenants who paid a rent in money or kind. Further, the growth of the woollen industry, a special feature of the period between 1450 and 1600, had created in certain parts of the

country, notably in the Eastern counties, a market for agricultural products, and in consequence a more commercial type of agriculture. The bulk of the farmers were still engaged in producing their own requirements, but a class was beginning to appear who grew food not only for themselves but, in addition, for the still small but increasing urban population. This growing commercialisation of agriculture was without doubt partly responsible for the appearance of a number of new works on agricultural subjects, and the introduction of printing in 1477 was destined to increase the influence of such works. Fitzherbert's book was produced in 1523 and by the end of the century had passed through at least twenty-one editions. It contains a discussion of the question of horses *v.* oxen as draught animals which is well worth quotation. He writes:—"It is to be knowen, whether is better, a plough of horses, or a plough of oxen, and therin me semeth oughte to be made a distinction. For in some places an oxe-plough is better; that is to say, in every place where-as the husband hath several pastures to put his oxen in whan they come from theyr warke, there the oxe-plough is better. For an oxe may not endure his warke, to labour all daye, and than to be put to the commons, or before the herdman, and to be set in a fold all nyghte without meate, and go to his labour in the mornynge. But and he be put in a good pasture all nyghte, he wyll labour moche of all the daye dayely.

"And oxen wyl plowe in tough cley, and upon hylly grounde where-as horses wyll stande still. And where-as is noo several pastures, there the horse-plough is better, for the horses may be teddered or tyed upon leys, balkes, or hades, where-as oxen maye not be kept: and it is not used to tedder them, but in few places.

"And horses wyl goo faster than oxen on even grounde or lyght grounde, and be quicker for cariage: but they be ferre more costly to kepe in winter, for they must have both hey and corne to eate, and straw for lytter; they must be well shodde on all foure fete, and the gere that they shal draw with is more costely than that for the oxen, and shorter whyle it wyll last. And oxen wyll eate but straw, and a lyttel hey, the whiche is not halfe the coste that horsis must have, and they have no shoes, as horses have. And if any sorance come to the horse, or (he) waxe olde, broysed, or blynde, then he is lyttell worthe. And if any sorance come to an oxe, (and he) waxe olde, broysed, or blinde, for 2s. he may be fedde, and thanne he is

mannes meate, and as good or better than ever he was. And the horse, whan he dyethe, is but caryen. And, therfore me semeth, all thynges consydered, the ploughe of oxen is moche more profitable than the ploughe of horses."

The relative advantages of horse and ox labour were canvassed for the next three centuries, to culminate in a blaze of controversy at the end of the 18th century, followed by the rapid substitution of horses for oxen.

Fitzherbert, discussing the qualities to be looked for in store cattle, tells us: "Se that he have a brode rib, and a thycke hyde, and to be lose-skinned, that it stycke not hard nor streyte to hys rybbes, for then he wyll not fede."

Passing on we come to Thomas Tusser, whose book, "One hundred points of good husbandry," subsequently enlarged to "Five hundred points of good husbandry," first appeared in 1557. The editors of the edition published by the English Dialect Society write: "If the number of editions through which an author's works pass be a proof of merit, as it certainly is of popularity, few writers of his time can enter into competition with Tusser. During the forty years from the appearance of the first edition of the 'One Hundred Poyntes' in 1557 to the end of the sixteenth century, no fewer than thirteen editions of his work are known to have been published. Yet all are scarce, and few of those surviving are perfect; a proof that what was intended for practical use had been sedulously applied to that purpose."

The book is full of information on the agricultural conditions of the times—space allows of but two quotations. In a section headed "Corne harvest equally divided into ten partes," he gives us a rough idea of the distribution of the costs of corn-growing.

"One part cast forth, for rent due out of hand,
One other part, for seede to sowe thy land,
Another, part, leaue Parson for his tieth.
Another part for harvest, sickle and sieth.
One part for plowwrite, cartwrite, knacker and smith,
One part to vphold thy teemes that drawe therewith.
One part for seruant and workmans wages lay.
One part likewise for filbellie day by day.
One part thy wife for needfull things doth craue.
Thyself and child, the last one part would haue."

In another section, "A comparison between Champion countaie and severall," he describes the advantages of enclosed

land and the disadvantages of the open fields with their scattered strips and common pastures and waste. One stanza reads :—

" More plentie of mutton and biefe,
corne, butter, and cheese of the best,
More wealth any where (to be brief),
more people, more handsome and prest,
Where find ye? (go search any coast)
than there where enclosure is most."

Thomas Tusser has sometimes been pointed to as an example of a " book-farmer " who failed miserably at practical farming and ended his days in poverty. There is good reason for regarding the latter point as inaccurate and consequently for modifying the description of his farming experiences. Tusser's will shows that at the time of his death he was owed £330 by his brother William, no small sum in those days, that he owned a copyhold of 7 acres and a rood in the Parish of Chesterton and had an interest in another holding from which he received a rent of 35s. annually.

In the last quarter of the sixteenth century appeared Barnaby Googe's translation, with additions, of the " Four Bookes of Husbandrie by Conradus Heresbachius " in 1577, and Leonard Mascall's " Government of Cattell " in 1596. Both these works enjoyed a considerable popularity and many subsequent editions were issued.

The disadvantages of the shallow ploughing of the time were drawn attention to by Barnaby Googe when he recommends night ploughing in hot weather in order to preserve the moisture. The growing impoverishment of the surface layer, especially in light soil areas, was making the application of manure of some sort imperative. The common system of farming was not conducive to the production of manure, and Googe recommends the growing and ploughing in of a crop of lupins as an alternative. This practice, though well known to classical writers, is not mentioned in any previous English work.

Leonard Mascall's " Government of Cattell," though in places entertaining and amusing, has little to recommend it. Shrewd sense is inextricably mixed up with grotesque nonsense, and a perusal of it leads one to sympathise with the attitude of the sixteenth and seventeenth century farmers to the recommendations of agricultural writers.

Other writers, of whom the most important is Sir Hugh Plat, bring the total for the sixteenth century to twelve. This figure

gives but an imperfect idea of the quantity of agricultural literature produced. Twenty-one editions of Fitzherbert's "Husbandry" are known to exist, but, the agricultural literature of this period is, bibliographically, almost virgin soil, and a careful investigation therefore is certain to bring to light fresh editions. The same may be said of the other writers of this period and a study of the quantity side might show the last quarter of the sixteenth century to be a period during which very considerable interest was manifested in the problems of rural economy.

Seventeenth Century.—Once started, the race of book farmers increased rapidly in numbers and in the seventeenth century attained to the respectable total of sixty.

Of these writers, the most prolific were Gervase Markham and Samuel Hartlib, but their work cannot compete in point of intrinsic value with Walter Blith's "English Improver," published in 1649, and John Worlidge's "Systema Agriculturae," 1669. The latter, though a fair-sized folio volume, passed through no fewer than six editions before the close of the century.

The keynote of these two works is improvement by means of enclosing, drainage, and better rotations, including the growing of leguminous forage crops, and that their suggestions did not bear fruit during this century is attributable, the writer thinks, to lack of confidence in the practical value of the ideas put forward by book farmers, to the conservativism of the smaller farmers, supported by the traditional routine of the open-field villages, and more particularly to the absence of an expanding market for agricultural produce. Population in the 600 years between the Norman Conquest and the end of the seventeenth century had probably not more than doubled, and agricultural change and progress had been slow in consequence.

Eighteenth Century.—The first half of the eighteenth century partakes of the character of the seventeenth, though signs of change are beginning to appear. These changes materialise in the latter half of the century, which in consequence is in strong contrast with the earlier period. A stimulus to agricultural improvement appeared on the scene and its influence was both immediate and widespread. The growth of population consequent upon the Industrial Revolution and the more than proportionate increase in the numbers of the town-dwellers made an increased production from the soil a matter of the first importance. This factor was reinforced by the almost complete severance of this country from sources of foreign supply as a result of the Napoleonic Wars, nor should the effects of the

accumulation of wealth made possible by the long period of internal peace and security be lost sight of.

The occasion produced the man, and Arthur Young gave to the English landlord and farmer such information, based mainly upon experience and observation, as enabled them to adopt the improved practices of the most advanced agriculturists.

Arthur Young stands at the head of a host of writers in the eighteenth century, and the real significance of this period in the history of agricultural development will only admit of accurate estimation when the literature of the period has been carefully studied both from the quantitative and qualitative side. Some idea of the volume of the literature of the eighteenth century may be gained from the figures for Arthur Young, one of a hundred writers; his contributions, including separate editions, are contained in approximately 250 volumes, few of which can be treated as mere reprints.

One of the best known agriculturists of this time was Robert Bakewell, of Dishley, in Derbyshire, whose work was mainly the improvement of live stock, and in this connection a document, the text of which is reprinted below, has recently come to light. It is interesting as establishing the truth of an historical rumour to the effect that at one point of his career Bakewell was on the verge of bankruptcy. Attempts to discredit this tradition have been made on the ground that no large sale of his stock could be proved to have taken place prior to his death. Here, however, is proof conclusive that the greatest of early pedigree stock breeders was at one time on the verge of financial ruin, from which he was only rescued by the generosity and public-spiritedness of many of the great landowners of the day.

To the NOBILITY, GENTRY and OTHERS,

The humble petition of Robert Bakewell, of Dishley, in the County of Leicester,

Sheweth,

That your Petitioner has for a Series of Years employed his Attention on a Plan for improving the Breed of Horses for Cavalry, Harness and Draught, as also of the Neat Cattle and Sheep.

That your Petitioner, in Pursuit of this Plan, had many difficulties to surmount, having the Prejudices of other Breeders to combat, and various Experiments to make, in order to ascertain which were the best kinds to breed from; and that such Experiments were attended with considerable Expence, and more Trouble than he can well convey a Sense of.

That your Petitioner apprehends he has brought all the different Kinds of Stock above-mentioned to a greater Degree of Perfection than has been done by any other Person, and thereby rendered important Services to this Country; and in this Opinion he hopes he is justified, by the best Judges having purchased from this Stock, at higher prices than from any other, and having sent them into the Counties of Bedford, Bucks, Cambridge, Chester, Cumberland, Derby, Devon, Dorset, Durham, Essex, Gloucester, Hereford, Herts, Huntingdon, Kent, Lancaster, Leicester, Lincoln, Norfolk, Northampton, Northumberland, Nottingham, Oxford, Rutland, Salop, Somerset, Southampton, Stafford, Suffolk, Sussex, Warwick, Westmoreland, Wilts, Worcester, York, into North Britain, Wales, Ireland, Germany, and Jamaica.

That your Petitioner has made considerable Improvements in Agriculture, Division of Lands, Watering of Meadows, &c.

That your Petitioner, in Consequence of the aforesaid Difficulties and Expences, as well as by many great and unavoidable losses, to the Amount of many Thousand Pounds, is rendered incapable of pursuing his Plan; and as a considerable Part of the Stock is soon to be sold, and probably will fall into the Hands of those who for Want of Experience, or other Causes, cannot be supposed to manage it to the same Advantage, consequently little if any further Improvement can be expected therefrom.

But, if the Public would take this Case into their Consideration, and grant him such Assistance as would enable him to purchase the Whole, or the best Part of this Stock, he is fully persuaded he could be highly instrumental to the general Good of this Nation, by continuing in his late Line of the Breeding Business, and carrying it forward in such a manner as will be most conducive to the public Service; and he apprehends he could make as great Improvement from the State the Stock is now in, as he has done from the State of Stock in general at the Time he began this Business, an Object he thinks of great Importance to the Honour and Interest of the British Empire; for if it be allowed that the Increase of Herbage by Improvement in Agriculture is a real Advantage to the Public in general, he conceives the Improvement of Stock, so as to gain a greater Quantity and better Quality of Flesh from such Herbage, to be of equal, if not of greater Importance.

Your Petitioner therefore most humbly solicits, &c.

PARASITIC DISEASES OF PIGS AND THEIR PREVENTION.

THOMAS W. M. CAMERON, M.A., B.Sc., PH.D., M.R.C.V.S.,
Institute of Agricultural Parasitology,
London School of Hygiene and Tropical Medicine.

ONE of the most important and most profitable of the food animals is the pig; its economic position at the present day shows how essential it is that all unnecessary loss in growth and life should be avoided.

There is a popular belief that to be happy and contented a pig should live in filth and feed on dirty food prepared in an uncleanly manner: at least if not actually a belief, this is so frequently practised as to be almost accepted as such. Yet nothing could be further from the case. It is true that when food has to be bought in, the margin of profit is often small; and to make pig-keeping pay, a large amount of by-products is necessary for feeding. It is, however, far from desirable that these food-stuffs should be dirty, and it is even less desirable that the surroundings of the animal should be perpetually filthy.

The more spectacular of the porcine diseases are bacterial: Tuberculosis, Swine Fever, Swine Erysipelas and so on, are not directly due to dirt, although with all these diseases good clean conditions and proper feeding would save a considerable amount of loss, and good hygiene is essential for their complete eradication. In the case of the animal parasites, however, bad filthy conditions are even more responsible for their continuance, and the dirt of food and sty contains the active sources of infection.

It is not generally recognised how great is the loss due to parasites in pigs and how much can easily be done to prevent it by means of effective hygiene. The object of this article is to indicate to some extent the trouble caused in this country by these pests and how far steps may be taken to avoid or at least minimise the resulting loss in pigs and pork.

Round-worm (*Ascaris*).—The most important parasite of pigs in this and other countries is *Ascaris lumbricoides*. This is a large pinkish-yellow round-worm with three microscopic lips surrounding the mouth opening. The female is nearly a foot long and is more or less straight with a pointed posterior end. The male is slightly smaller and is bent posteriorly. This parasite is identical with the large round-worm of human beings, although it is possible that the pig form is a distinct strain which will not become adult in man. These parasites live

normally in the small intestine, although they have a habit of wandering into other situations, such as the stomach and bile-duct. It is extremely common in this country and may be seen in numbers practically any day in any abattoir where pigs are slaughtered.

The female, after mating, lays in the intestine millions of tiny eggs, which are carried to the exterior in the droppings. The eggs possess very thick shells, are remarkably resistant to all adverse conditions, and may remain alive for several years after leaving the body.

The eggs are laid in an undeveloped condition, and if accidentally swallowed at this stage do not infect the animal. After two or three weeks, however, if they have been under favourable conditions, and have received moisture, warmth and oxygen, a small worm embryo develops in each and may be watched (under the microscope) moving about in the egg-shell. It has now reached the infective stage, but it does not hatch until it is swallowed. It was once supposed that when the egg was swallowed, the young worm escaped in the stomach, and settling down in the intestine developed into a full-grown adult. Recent experimental work, however, has shown that its life story is much more complicated than this. The egg hatches in the intestine, it is true, but immediately the young worm (about one-hundredth of an inch long) burrows into the intestinal wall and reaches the blood stream. It is carried to the liver, and thence viâ the heart to the lungs. There it leaves the blood and passes up the windpipe to the gullet, is swallowed and reaches the intestine for the second time, about ten days after leaving it and about ten times its original size. It now settles down to the business of growing, and about ten weeks after being swallowed is producing eggs. The whole life-cycle thus takes about three months from the time the egg was laid until the worm is fully mature.

For many years, the *Ascaris* was known to be responsible for considerable damage among pigs, but it is only since this amazing life-cycle has been worked out that it has been understood to what an enormous extent it causes trouble.

In passing through the lungs, the young parasites cause great irritation and rupture many small blood vessels. If many are present at the same time, they give rise to pneumonia, which may prove fatal. Now it is a curious fact that in worm diseases in general, young animals are more susceptible than adults, and this disease is no exception. The young animals are attacked

at the most critical time of their life, and if they survive the attack, they do not continue to grow properly, but remain small and stunted. The growing period in a pig is very short, and if arrested it means a permanently small animal with a consequent serious loss to the farmer.

The fully grown worms also cause some damage. They bite the intestinal lining by means of their three-lipped mouth, and as they often change their position and are usually present in numbers, they cause considerable harm in that way. Moreover, they permit the entrance of harmful bacteria and may thus originate some disease which would not otherwise obtain a hold, while it has recently been found that the adults produce a poison which is probable responsible for a certain amount of anæmia.

The damage thus done may be considerable, but it is small compared with that done by the young worm in its journey through the delicate living tissue. The adult worm can easily be removed by suitable drugs—several are available—but there is no drug which will kill the young worms once they have entered the body and started to invade the blood stream. Here, however, a knowledge of the peculiar life-cycle has suggested an effective means of prevention, which has been used in America with the utmost success. The method consists of careful preparation before the birth of the young pig. It is easy to tell by means of the microscope if the pigs in a yard are infected. The small eggs are characteristic, even if one cannot definitely see any symptoms. A clean farrowing pen must be provided for the sow a few days before farrowing. By "clean" is meant absolutely free from Ascarid eggs. All litter must be removed and the floor and walls should be scrubbed with boiling water and soda lye, or a carbolic disinfectant: plenty of boiling water should be used. The pen must not open to the yard, as while the sow is in it, she must not be permitted to have access to infected spots—as the yard is sure to be. The sow, before being placed in the pen, must also be cleaned—especially the udders—with soap and water, as eggs are liable to stick to the skin, and she should, if possible, be freed from adult worms. It would obviously be futile to employ a clean pen, if the sow brought in and fed to her young, millions of eggs.

After farrowing, in about 10 to 14 days, the sow and the litter are removed in a cart direct from the sty without touching the yard, to a temporary pasture to which pigs have not had

access for several years and which is definitely separated from the styes. Water should be supplied by pipe or in pails (not as ponds) and no other pigs should have access to this pasture. Here the pigs should be kept until about 4 months old, when they may be safely moved back to the old sty. They will acquire an infection there, it is true, but it will be too late to interfere with the growth, and there will not be the loss due to pneumonia and stunted growth which would otherwise have occurred. This system may require adaptation to meet local circumstances, but the important point is to raise young animals in a free spot free from Ascarid eggs, until they are sufficiently grown to be more or less resistant. Particularly to be avoided are permanent pastures. The extra trouble involved in this system is more than repaid by the decrease in infant pig mortality.

Husk or Hoose.—Another genus of worm parasites of considerable economic importance is *Metastrongylus*, the cause of the familiar " husk " or " hoose " in pigs. Two species are known in this country, both very similar and both frequently found in the same animal. The females measure about 1 to 2 in. long, the males being half this length. Both species are very slender and live in the branches of the windpipe. They consequently cause a verminous bronchitis, characterised by a cough, which may develop into pneumonia. As in the previous species, they are much more serious parasites in young animals than in adults.

The life-cycle is still unsolved. The adult female lays eggs which hatch in the lungs and the larvæ ascend the windpipe, are swallowed and reach the exterior in the droppings. The course of their subsequent development is unknown, and consequently a definite scheme of attack—such as is used against *Ascaris*—is not at present available. Prevention is thus so far simply a matter of hygiene. Pigs reared under healthy surroundings are much less likely to become infected: and if they should contract the disease, are much more likely to recover completely.

Other Round-worms.—There are three other species of round-worms not uncommon in pigs in this country, which if of less clinical importance are yet of considerable interest.

The first species is a very minute, pinkish, hair-like parasite—a relation of the Stomach-worm of sheep—which lives in the stomach of pigs and is called *Hyostrongylus rubidus*. The female is only about $\frac{1}{4}$ in. long—the male is even smaller—and is scarcely visible to the naked eye. It has generally been

associated with a certain amount of inflammation of the stomach, but has recently been found in healthy pigs. The female lays numerous small eggs, which pass to the exterior in the droppings, and after a short time hatch. The minute embryo which emerges, feeds, grows, moults and in a few days has reached the infective stage. The embryos live in damp situations, and if at this stage they are eaten by the pig they continue their development into adult worms. In this case, prevention is again a matter of hygiene. The infected manure and litter should be removed to a place inaccessible to pigs.

The second species, a close relation to the parasite of "Pimply-gut" in sheep, goats and cattle, lives in the large intestine. It is called *Oesophagostomum dentatum*. Both sexes are under 1 in. long, but are white stoutish worms which are visible to the naked eye. They do not appear to cause nodule formation on the gut wall, as do the forms in ruminants, but they are responsible for diffuse centres of inflammation. So far, however, they have not been associated with any well-defined clinical symptoms. Their life cycle has not been fully worked out; but it appears to be similar, in the free-living stages, at least, to that described for the previous species. They are, however, rather more resistant to adverse conditions, such as drying, and infection would in consequence be more difficult to prevent.

The Whip-worm.—A more common species in pigs in this country is the whip-worm (*Trichuris suis*), which lives in the cæcum. These are small whitish worms with a thin thread-like anterior portion—hence the popular name of "whip-worm." The thin anterior portion is threaded through the lining of the cæcum and the parasite feeds on the juices thus found. The posterior portion—straight in the female, coiled in the male—lies free in the intestine. Directly, these parasites seem to do little harm; but indirectly, they may be the means of admitting pathogenic bacteria. Their life history is unknown.

The round-worms described above all occur in this country, and all do more or less damage. Many other species are, however, found abroad, some of them in temperate climates and under conditions which might permit their living in this country should they be introduced.

Trichinosis.—The most important of the Trichinæ is *Trichinella spiralis*. The adult parasite is a very minute worm, living in the small intestine of the pig. It does not lay eggs as do the other species, but produces living larvæ. Some of these pass to the exterior in the droppings, but others reach the blood

stream, and are carried to the muscles, where they encyst. They remain there until they are eaten by some flesh-eating animal, when they develop to maturity in the intestine and repeat the circle. The natural host of this parasite seems to be the rat, but man may be infected, with very serious results. The encysted infected forms in pork are not as a rule visible to the naked eye, and in some countries a special meat inspection staff is employed in order to detect their presence. Fortunately they seem to be absent from this country now, though two years ago some cases were reported from Wales.

Liver-Fluke and Tape-worms.—The flat-worms in the pig are of less importance than the round-worms.

The *liver fluke* of sheep will also live in the pig, but economically is not of the same importance as in the case of sheep. It is nevertheless wise to remember that the pig is a suitable host, and may act as a reservoir for the parasite. The fluke passes part of its life history in a small fresh-water snail, which can of course be infected by embryos hatched from eggs passed by the pig.

There are no adult *tape-worms* found in the pig, but the pig is the host of a number of intermediate cystic stages of the tape-worms of man and the dog. The human tapeworm (*Tænia solium*) finds its intermediate host normally in the pig. Fortunately, this parasite is now very rare, and appears to be absent from Britain. A more important cyst is the well known Hydatid —the intermediate stage of a very small tape-worm in the dog. This is one of the most important parasites in this country—but from the Public Health rather than the economic point of view. Man may be infected by swallowing one of the tape-worm eggs passed by the dog, and the Hydatid will develop in him with, generally, very serious results. The importance of the pig is therefore rather as a reservoir host for the infection of the dog and subsequently of man. The cyst is slow growing, and owing to the usually early slaughter of pigs, it seldom reaches large dimensions in this animal. Cases are on record, however, where the liver of a pig has been found to weigh over forty times its normal weight owing to the presence of these cysts.

Skin Parasites.—*Lice.*—Only two parasites of the skin of pigs are of importance. The better known and common one in this country is the Pig louse (*Hæmatopinus suis*). This is the largest of the lice of the domestic animals—it is nearly ¼ in. long—and lives only on the pig. It is a most vicious blood-sucker, and attacks animals of all ages and in all countries. It

is most frequently found near the ears, on the breast and on the inner surface of the elbows. It is very common in Britain. It causes intense itching, and a serum which oozes from the spots where it has punctured the skin causes a mange-like scale. In some parts of the country it is an extremely serious parasite. Its presence interferes with growth and fattening, and young pigs often die from the loss of blood and the extreme irritation. The female attaches her eggs to the bristle by means of a viscid cement which she secretes. Young forms, resembling the adult in shape, emerge in about a week. They moult several times, and in about a month are sexually mature. During the whole life they do not leave the body except accidentally.

In the treatment of this animal by means of one of the various parasiticides applied to the skin as dip, wallow, spray or hand dressing, it is important to remember that the application should be repeated at least three times at intervals of seven to ten days in order to destroy the young forms which emerge from the eggs not destroyed by the insecticide. At the same time as the animal is treated, the sty must be disinfected, while the bedding should be burned. A useful preventive measure is the occasional addition of 5 per cent. creolin to the wallows. This simple measure has been found extremely useful in practice.

Mange.—Sarcoptic mange in pigs is not common in this country—the condition resembling it clinically being most frequently due to lice. It is becoming increasingly prevalent in America, where it causes serious losses. The parasite is closely related to the mite causing Scabies in man. The adult female lives in a burrow in the skin, and by the irritation of her presence causes the exudation of serum with the production of the familiar scab. Her eggs are laid in this burrow. The eggs hatch, and the young mites reach the scab, where after twice moulting they become adult, and commence a fresh burrow. It is estimated that in about three months, a single female will give rise to a million and a half mites. They cause great itchiness. and as the pig rubs itself to ease this, the scab gets broken off and the mites are disseminated. They are generally found in the head region of the pig, but if unchecked they spread all over the body. Once established, the mange mite is a very serious parasite, and may cause the death of the animal. The skin too, is rendered useless, even if the animal is cured.

In this case treatment should be repeated three times at intervals of five to eight days in order to destroy the forms newly-emerged from the eggs.

General Conditions.—The most important of the parasitic infections discussed above, in this country at least, are those due to *Ascaris*, lungworms and lice, and their greatest effect is felt in the young animals. The greatest losses in young pigs are apparently due to diseases caused by defective feeding—such as rickets—or by animal parasites, and both sets of conditions are not difficult to remedy. It is an axiom in sanitary science that no animal can exist in a more or less enduring contact with its own body wastes without the risk—sooner or later—of an outbreak of disease, and owing to the prevalence of these three parasites in Britain, this risk becomes a certainty, and the mortality —especially in young animals—is extremely high. On the other hand, in well-kept, hygienic styes, parasitic disease can be kept to a minimum and the result is immediately apparent in increase of condition and decrease of mortality. Adequate drainage is essential, and no pools should be allowed to exist to which the pigs have access. Feeding from the ground is to be avoided, and the provision of raised sleeping quarters which the pigs learn not to defile is desirable. Manure removal should be thorough and frequent, and the pigs should not have access to the manure beds. Cleanliness must not be superficial, as this gives merely a false sense of security and is not true economy. Disinfection is also useless if rubbish and infective litter are left in the pen.

In eradication of parasitic worms, it is well to remember that while treatment is the province of the veterinary surgeon, prevention through hygienic measures can only be carried out by the stock-breeder. Patent medicines—especially those mixed with the food—are often useless in removing parasites, and their use is to be deprecated.

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OATS : VARIETIES AND CULTIVATION.

ALTHOUGH the depredations of frit-fly* have done much to discourage the growing of spring oats, their importance is still great. Owing to the large number of varieties on the market, farmers find some difficulty in deciding which are likely to be most suited to their conditions.

Varieties of Spring Oats.—Generally speaking, in England and Wales on the best types of soil, Victory and Abundance are likely to give good results; it is probable that the latter gives a slightly heavier crop, but it is not so strong in the straw and is liable to "lodge" if following a heavily manured crop. Crown oats also yield well on good land. Supreme (black)† and

* *See* Leaflet No. 202, "The Frit Fly."

† Except where otherwise stated the colour of the husk is white.

Golden Rain (yellow) do well on similar soil and are to be recommended where conditions are conducive to late ripening, while Yielder often does particularly well on exceptionally heavy land. In Wales, Record has been found suitable on good quality soils when seed mixtures are sown under the oat crop. The Potato oat is a popular variety on good land in the hilly districts of the North-West of England where rainfall is high. It is not a success, however, in other parts of the country. For soils of moderate fertility Black Tartarian (black) is to be recommended, but where late ripening is anticipated Waverley, Record or Black Bell III (black) may give better results. Black Tartarian does not tiller well, but has been found to give good crops on poor land in coastal districts. If broadcast on an old broken up ley, as is often the practice in Wales, it is particularly susceptible to the depredations of wire-worm. Where soils of under average fertility are in question, Black Tartarian is the most hopeful variety. In Wales and Herefordshire, Radnorshire Sprig has done well under these conditions. Ceirch du Bach and Welsh Strigosa are particularly adapted to high-lying land in Wales, the latter giving crops on land of the lowest productivity. Cornish Black, an oat very similar to Ceirch du Bach, is successful under similar conditions in Cornwall. The two Welsh varieties are invariably chaffed without thrashing.

Cultivation.—It is essential for successful growing of spring oats that they should be sown early on a good seed-bed. For early sowing 3 bushels are sufficient if drilled. If broadcast 4 to 5 bushels are required. For later drilling 4 bushels should be seeded. Crops drilled in England in February or the first half of March, have usually sufficiently developed by the last half of May to be practically immune from the attacks of the first frit-fly broods, which are then at their height. In unfavourable seasons, small top dressings of nitrate of soda or nitrate of lime stimulate growth, and thus may bring the plants past this critical period. If sowing is carried out later than the middle of March, heavy seeding may help to compensate for frit-fly damage, but generally it is better to substitute barley under these circumstances. On land where early sowing is usually impossible it is wiser to grow winter oats instead. These latter have the additional advantage that they usually produce a heavy crop of high quality. Winter oats are also to be preferred to spring oats on land where charlock is prevalent.

Varieties of Winter Oats.—Three varieties are commonly grown, namely, Grey Winter Oat, Black Winter Oat, and Bounti-

ful Black Oat. In deciding which to grow, farmers should be guided largely by local experience, for while all may grow equally well in any particular district, there is sometimes a keener local demand by merchants for one than for another. The black varieties possess somewhat stronger straw than the grey variety, and might generally be given the preference where oats are subject to "lodging." The Grey Winter Oat, however, appears to be the most hardy of all the winter varieties. Black Winter Oat is more liable to shed its seed than the grey variety, and should be cut before it is dead ripe. In no case, perhaps, is the straw of winter oats so nutritious as that of the finer spring varieties, but when chaffed and mixed with cake and meal it is readily eaten by stock. A white variety, Marvellous, has recently been introduced, which, possessing stiff, upstanding straw, has given big yields following mild winters on rich land. The grain is bigger than that of the commoner winter varieties, and Marvellous should therefore be sown at a relatively thicker rate.

Soil and Cultivation.—Winter oats are suited to a wide range of soils. They can be grown successfully on soils too light or too poor for wheat, and they prevent such soils from "washing" in a wet winter. Further, they can be taken as a second corn crop, provided the land is clean. They must be sown early, preferably in September, so that the plants may become well established before cold weather sets in. (They may also, however, be sown in spring—see last paragraph, p. 434.) Winter oats very seldom suffer appreciably from the attacks of frit-fly, since, by the time the flies appear in spring, the oats have ordinarily grown to a size at which they are not susceptible to attack. They may, however, be severely injured by over-wintering frit maggots when the crop is sown after a ley containing grasses (especially rye grass), *which was not ploughed until autumn or winter.* In such a case the maggots migrate from the ploughed turf to the young oat plant; the remedy is to plough the ley after the hay crop is taken and sacrifice the aftermath. Bountiful is, if anything, the least hardy of the three common varieties, and tillers least. It is best adapted to the mildest districts, and requires somewhat richer land than the others; it stands up well.

Unless the land is thoroughly clean, weeds are favoured by a longer growing period than usual, and may seriously reduce the crop. About 3 to 4 bushels per acre should be drilled; for broadcasting 4 to 5 bushels are required. The earlier the sowing and the cleaner the land the less the quantity of seed necessary. Winter oats are generally ready for cutting from ten days to a

fortnight before other corn crops. This enables the land to be prepared sooner for the following crop, a point of some importance when farming is conducted at high pressure. When taken as a second straw crop, artificial manures will generally be necessary —say 2 cwt. superphosphate and 2 cwt. kainit at seed time, followed by a top dressing of ¾ cwt. sulphate of ammonia or 1 cwt. nitrate of soda in the spring.

Suitability for Spring Sowing.—Experience in Derbyshire seems to indicate that Grey Winter or Black Winter Oats sown about the end of March, are more reliable than the commoner spring sorts, especially on grass land just ploughed out. This practice is only advisable in early districts, where the strong tillering habit of the varieties named minimises the effect of the frit-fly attack. Bountiful was originally grown chiefly as a spring oat.

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HOME CURING OF BACON.

E. PRATT SADDINGTON.

Type and Treatment of Pig.—In the production of prime bacon one must begin well, and it is essential to have in mind the importance of choice of pig, housing and feeding. Careful attention in this way means very much toward success, whilst neglect brings probable or certain failure. The animal should be of the type calculated to give satisfactory results by way of growth and quality of flesh in the right position, with good proportion of lean, there being few people who really enjoy fat bacon, and when fat is excessive it is often a source of great waste.

Many consider the pig to be a dirty animal and treat it accordingly, but actually it thrives and gives best results from every point of view, when kept under clean conditions. The piggery should be dry, roomy, light and well ventilated, but the animal must not be exposed to strong sun or to draughts.

Moderate exercise is beneficial, preventing cramp and other ailments. Daily cleansing and an occasional lime-washing of the sty will minimise the unpleasant odour generally associated with such buildings, and which often acts as a deterrent to the keeping of pigs.

Food should be as fresh as possible, clean, of suitable proportions and given at regular intervals, in quantities readily cleared up. It is distinctly wrong to allow accumulations of stale food in the piggery or elsewhere.

Highly fermented, strong-smelling foods are likely to have a bad effect upon the appetite and health of the animal and consequently upon the bacon. Fish-meal must be of best quality and used with discretion or the flesh is apt to be tainted. Vegetable oils in too large proportion produce soft, oily fat with a tendency to turn yellow.

For commercial purposes the carcass should not weigh more than 200 lb., but for home use a rather larger carcass may, under some circumstances, be found convenient, although it is not economical to keep a pig longer than seven to eight months, since quite 3½ lb. of meal is required daily for maintenance alone.

Slaughtering and Dressing.—The best time for slaughter is from November to February, when flies are less active and weather of more suitable temperature. The slaughter-house should be clean, and situated at no great distance from the piggery in order to avoid undue excitement when transferring the animal. It is fairly common knowledge that, if the pig is in a high state of perspiration at the time of slaughter, curing may be difficult.

Accumulations of dust and rubbish where flies may congregate should be removed. The carcass may readily become tainted from drains or foul odours of any description. If possible a current of clean air should pass through the slaughter-house. A competent man should be chosen to carry out the actual slaughter, dressing and cutting up.

When it is decided to convert the carcass into bacon, the pig must be fasted for twenty-four hours, but its discomfort may be lessened by allowing it plenty of clean water.

When being taken from the sty the animal must not be beaten, bruised or roughly handled in any way, and twisting or jerking of the legs should be carefully avoided. Bruised flesh does not cure, and hams frequently go wrong because the joints have been injured. Even a small bruise will cause accumulation of blood, which develops an unpleasant odour, and surrounding parts quickly become tainted.

A plentiful supply of both cold and boiling water is necessary when scalding, and clean, dry straw if it is intended to singe. The use of too hot water blisters and discolours the skin, as does the flame when unskilfully applied, so that care is essential if one would have bacon of good appearance. After dressing the carcass should be allowed to hang until cold, but

not longer than 24 hours after scalding, or curing may be indifferent.

Methods of cutting up vary. Many take out much of the lean for the making of pies, sausages and other tasty dishes, but this is unwise as it leaves too large a proportion of fat for bacon. All trimmings can be utilised, so that no rough, irregular pieces should be left on the bacon. The carcass is easier to handle if the hams are cut out and dealt with separately, but there is more cut surface, which means additional waste and shrinkage.

Curing.—The place where curing is effected must be clean, cool and free from flies. It is well to turn out the apartment thoroughly and lime-wash, where possible. There must be no perceptible odour from drains, nor must strong-smelling foods, such as fish or onions, be permitted in the vicinity of the bacon. A salting trough or tub is the most practical thing, but when this is not available a clean board, shelf, table or brick thrall such as is found in most cellars and dairies would serve the purpose for dry-salting. For hams only earthen vessels are used. Metal utensils are unsuitable.

Ingredients should be of the best quality. Salt should be pure, fine and dry, and that prepared for table use is not recommended for this purpose. Saltpetre should also be pure, fine and dry. It is used to preserve the red colour of the lean, and is, therefore, especially useful in the ham and shoulder. When applied in large quantities it hardens the meat, but correctly used is decidedly helpful. Sugar prevents hardening and shrinking of the fibres, and gives flavour.

Bay salt is considered less harsh than the ordinary kind and is sometimes used in equal quantities with, but never wholly taking the place of, common salt. Salt should be prepared by drying and crushing it into fine powder. Saltpetre is better purchased from a reliable chemist, who will grind it, and, as far as is possible, will guarantee its purity.

The best Demerara sugar is preferable to the common brown variety. The recipes for curing are numerous and varied, but the following are simple and give good results. No great skill is necessary, but cleanliness, accuracy in weighing out ingredients, thorough rubbing of all parts until the surface feels slightly moist, and general attention to detail are essential to success.

(1) For every 20 lb. of meat allow 1½ lb. to 2 lb. salt, 1 oz. saltpetre, ½ lb. Demerara sugar. Rub the meat with salt only and leave the cut or

meat surface uppermost until next day. Drain away blood and moisture. Rub thoroughly, especially the ham and shoulder, with saltpetre, then with sugar and salt mixed, repeating the rubbing daily with sugar and salt until all is used, which will be in three to four days. Turn the bacon each day during the rubbing period.

Leave for three to four weeks, turning once weekly, and pouring the liquid over the bacon frequently if salting in a vessel where it accumulates. If a board or shelf is used this cannot of course be done.

Hams require four weeks and if they are cured in the side the whole must be left for that length of time. When curing is complete the next thing is to prepare for drying. With clean, cold water, rinse away all surplus salt, wipe with clean, dry cloths, scatter pepper freely around bones and in places where flies are likely to attack, and hang to dry in a warm room, but not too warm or the bacon will rust. To keep off dust whilst drying it is well to cover with muslin or even loosely with paper.

In about three weeks it should be dried sufficiently. It should be regularly dry and firm all over, but not hard and as unbendable as a board. The odour should be mild and pleasant. Place in calico or hessian bags and store in a cool, dry, well-ventilated room. It is better to suspend separately and not to place one side upon another in boxes or otherwise. Examine occasionally. If soft damp patches appear it is not keeping as it should, but this is not a common occurrence unless through neglect. If there is reason to doubt the keeping quality of ham or bacon plunge a knitting pin or thin sharp knife to the bone, draw it out, and the odour which clings to it will indicate whether the bacon is good or otherwise.

Some object to the flavour of sugar and prefer salt and saltpetre only. The latter make very good bacon, which cures and keeps well, but is inclined to be harder than when sugar is employed.

(2) For every 20 lb. of meat allow 2 lb. salt and 1 oz. saltpetre. Rub thoroughly, both skin and cut surface, with saltpetre, then with salt. Place one side upon the other with a good sprinkling of salt beneath, between and on the top, and leave for three to four weeks, turning the bacon weekly. The hams usually require four weeks and if cured in the sides the whole must be given that time, otherwise the bacon may be removed and the hams left a week longer. Drain away dissolved salt. When curing is complete, wash, to free it from surplus salt, wipe with clean absorbent cloth, and hang to dry as before directed.

Head and Feet.—The head and feet should be cured in the same way as the sides and may be placed in the same receptacle, but careful watch must be kept as the offal occasionally does not cure well, and should this happen, the bacon would be tainted by contact. After curing, the chaps, which are the lower part of the head, may be dried and kept for months, but the other parts are better cooked within three weeks. They make excellent brawn.

Smoked Bacon.—If smoked bacon is desired and no properly constructed room is available, there are places where this can

be done for a small charge. A room may be improvised, but a suitable building must be chosen. The walls and floor must be fireproof. After the bacon is cured instead of hanging to dry in the ordinary way the sides are suspended from the roof of the building. Upon the floor is placed a layer of clean, dry straw, and upon this, to the depth of three inches, a layer of sawdust. The straw is set alight and the sawdust smoulders, giving off the requisite smoke, in which the bacon should hang. This must be kept going continuously for from several days to a month according to the flavour desired. If only a mild smoking is required a few days in the room is sufficient, but the bacon must be thoroughly dried before storing, as in the case of plain curing.

The sawdust must be clean and dry and preferably from oak; that from the resinous woods is unsuitable.

The lower-priced, inferior smoked bacon one finds on the market is flavoured by immersing in a " smoke " bath, but this method is not recommended. If properly handled bacon will keep good a year or longer, and it should not be cooked under three months from the time of slaughter, although some really enjoy it when it has just finished drying.

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A BIRD'S-EYE VIEW OF CANADIAN FARMING.

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THE following notes were compiled in the course of a tour with the British Association for the Advancement of Science during the summer of 1924, and may be of interest as giving some idea of the conditions of farming and the methods adopted in Canada.

Agricultural Area.—The total area of Canada is in the neighbourhood of 2,300 million acres. This is larger than the United States of America, and more than sixty times the size of England and Wales, but owing to extensive regions which are not suitable for agriculture, the area which is fit for cultivation is estimated to be less than 30 per cent. of the whole. Small as this percentage may seem, it comprises some 631 million acres, of which not more than 10 per cent.—an area rather less than twice the size of England and Wales—has so far been brought into an improved condition, so that the possible development of Canadian agriculture is very great.

This agricultural zone may be divided approximately into two main parts (1) that which lies east of Lake Winnipeg, a well-wooded country, which possesses to-day a form of farming similar in many respects to our own, and (2) the west, the great wheat-producing prairies, which have exceptionally fertile soils of dark loam, varying in depth from one to ten feet.

Sixty-four per cent. of the total cultivated area is to be found in the three prairie provinces of Manitoba, Saskatchewan and Alberta, whose plains therefore constitute the largest agricultural section of the country, and of the $36\frac{1}{2}$ million acres of farm lands to be found there, at least 22 million acres are devoted to wheat, a figure with which the $1\frac{3}{4}$ million acres of the same crop in England and Wales can hardly be compared.

Agricultural Development. — Canadian agriculture has advanced at a phenomenal rate. A single lifetime there has seen what it took centuries for our own country to accomplish. First the grazier, then the cereal grower, and later the rotation farmer. The tendency is for the latter to move westward in the wake of the wheat zone, and thus it is found that Manitoba has already fallen to third place in the matter of wheat production, and is now making great strides in dairying, poultry farming, bee-keeping, etc.

The increase in wheat production is therefore a net gain, representing the balance between the encroachments of rotation farming from the east on the one hand, and the breaking of virgin soils taken over from the west and north on the other. Although wheat is now the main crop in the country, it is equalled in average by the combined acreages of .oats, barley and rye, which shows that in Canada farming and wheat production are by no means synonymous terms. About half the total value of all the farm products of the country is represented by field crops, the remaining half being made up, in order of importance, of live stock, milk, butter, together with cheese and cream, eggs, vegetables, fruit, maple sugar and syrup, wool and honey. The high percentage of field crops is mainly accounted for by the enormous quantities of wheat grown for export, the record being reached in 1923, when more than 400 million bushels were produced.

These figures give a fair indication of the powerful influence which the West exerts in the general scheme of the agriculture of the country, though, as might be expected, the older eastern provinces, Quebec and Ontario, easily hold the lead in the matter of horses, pigs, meat products, eggs, butter and similar commo-

dities, a good deal of which helps to satisfy the ever-growing demands of the more populous United States.

Growth of Population.—It is interesting to note that, whereas both the urban and the rural population of the West has risen by leaps and bounds, it is only the urban population which has increased in the east of late years. It is not difficult to assign as a reason for this, that, apart from the steady flow of immigrants to the West, the farmers of eastern Canada are moving on to the prairies to take up corn-growing, as is evidenced by a comparison of the figures for cattle, which have hardly increased at all in either east or west during the same period.

The population of Canada is essentially fluid, and this applies not only to the Dominion but to the whole North American continent. A great deal is heard about the loss of population owing to the drifting down into the United States of many who hope in this way to improve their lot, but not so much is heard of the counter movement from south to north, which is a very real factor in the situation, and is due to some extent to the advantages which the farmer of the Canadian West has over his more southern neighbour. Briefly, these advantages are that the Canadian prairies give a higher yield of better quality wheat than the United States, while land values, rents and interest burdens are lower, and freight rates are less. When, in addition, it is remembered that only about one-tenth of the cultivable area has as yet been brought under the plough, it is undoubtedly true that Canada offers great opportunities to anyone of spirit and enterprise, who is prepared to take a share in developing those vast resources.

To become a prairie farmer it is by no means necessary to embark on an extensive holding. The Dominion lands, from which the demand for new farms is largely met, comprise some 150 million acres of potential farm lands, and these are divided into sections of 640 acres each. A quarter-section, of 160 acres, forms the unit which is granted to settlers by the Department of the Interior, and thus we find that the average holding is just over 150 acres, and only 18 per cent. of the farms in the country are more than 200 acres in extent.

The Eastern Provinces and British Columbia.—The agriculture of the eastern provinces approximates more nearly to European methods than to those of the prairie provinces. Potatoes, poultry, dairying and stock raising are the chief concerns of Prince Edward Island; fruit growing of Nova Scotia; and stock raising, dairying and poultry of New Brunswick. Practically

every form of mixed farming is to be found in Quebec, whilst the backbone of Ontario is the dairy industry, although stock raising, tobacco growing, sugar beet and flax all receive due attention. Mention should also be made of the wonderfully fertile Niagara belt, with its complete service of electric trains, where some of the choicest fruit in the world is grown.

In British Columbia, a real home from home for the British settler, the chief agricultural interest is centred upon fruit, with poultry, butter and cheese, hops, honey, vegetables, flowering bulbs, goats and rabbits as additional flourishing industries.

The West: Rotations versus Continuous Cropping.—As far as the West is concerned, a different set of factors is met, but even there it is rapidly coming to be realised that the introduction of rotations is the only way of getting a steady profit from the land. It is found already that continuous cropping with wheat, with just sufficient bare fallow to combat the deficiency of moisture, is yielding to some such rotation as wheat, wheat, barley or oats, seeds (first year for hay, second year for pasture), and then wheat again, whilst hoed crops are now by no means unknown on the prairies.

Generally speaking, however, the continuous growing of grain has not progressed so far as to reduce the yields seriously, though experiments have shown that a rotation of two years of wheat followed by one year of fallow has resulted in a decrease in some prairie soils of 30 per cent. of the nitrogen in 20 years.

The controlling elements are still such matters as rainfall, weeds and pests, and, as has been indicated, the one stand-by of the farmer in his endeavour to increase the soil moisture has been the summer fallow. This, however, is by no means a desirable method as it undoubtedly leads to the destruction of the valuable soil fibre, and allows drifting and loss of surface soil. It is disappointing to find in the morning that some of the best of your farm has blown on to your neighbour's holding. Moreover, the fallow may lead to a loss of nitrogen and organic matter in many cases greater than the normal amount taken out by a crop. In fact, it counteracts the one great advantage of the long and severe winter, which locks up the nitrogen supply in the autumn and only liberates it in spring and summer, when there should be a crop of some sort to make use of it.

There is yet another way of combating the evil effects of drought, and that is by irrigation, and already a great tract of land, three-quarters the size of Wales, is being lucratively farmed in Alberta under the Canadian Pacific Railway Bassano Dam irrigation scheme.

A Labour Difficulty.—There is one problem of the West which at present defies solution, and it is an important one. Any system of farming, whose sole aim is to produce a single cereal crop which only comes to maturity once in the course of a year, must in the nature of things give rise to a very fluctuating demand for labour. From the beginning of harvest until the thrashed grain has been delivered to the local elevator, or put on rail, the labour which is available locally is swept off its feet. In order to cope with the volume of work, encouragement is given to the temporary migration from the eastern provinces and from the United States of about 25,000 harvesters each year, and in 1923 this number was supplemented by 12,000 men brought over from the British Isles. At the end of the season, when the farm work practically closes down for 5 or 6 months, the farmers have no choice but to turn away most of these extra hands. It is impossible to see that they could act otherwise under the circumstances, but this does not obscure the fact that it is an economic weakness in the business of wheat production as at present organised.

Live Stock.—What would bring the prairies undoubted benefit would be plenty of manure, and manure pre-supposes live stock, and live stock means labour, but the difficulty about live stock is that hitherto it has had to be housed in winter. It is hard to imagine a farmer housing his ewe flock for six months at a time, but that is what happens out there, with the result that most farmers do not bother with a ewe flock at all. Ontario and Quebec each carry more sheep than all the other provinces added together. Recently, however, in the east and as far west as the Red River basin about Winnipeg, the experiment has been successfully tried of letting cattle run loose in the bush with rough shelters to prevent their falling victims to the snow squalls. In addition the Department of Agriculture have set on foot serious experiments in crossing the domestic breeds of cattle with the bison in an endeavour to evolve a breed which shall combine the utility points of the former with the hardiness of the latter. Of the domestic breeds there are something like fifty in the Dominion, but education has had the salutary effect of bringing some few of the better breeds well to the front. As far as dairying is concerned, Ayrshires and Holsteins appear to be the most popular breeds at present.

As regards winter keep, roots are hardly grown at all. Silage, usually of maize or sunflower, is the staple fodder in winter, and of this and of good hay there need be no shortage.

At present the farmer usually yields to the temptation to grow wheat, and nothing else, but this is changing, as may be judged from the fact that the prairie provinces, besides providing for their own internal needs in the matter of dairy produce, are now actually exporting cheese and butter in increasing quantities.

Wheat Improvement.—As regards the improvement of the wheat plant itself much remains to be done. The period of the year during which vegetable growth is possible is much shorter than in some other temperate climates, so that the farmer is engaged throughout the summer in a race against time. Especially is this so for the prairie farmer, who relies so much on a single crop, and who is handicapped by the freezing of the great lakes and the resulting difficulties of transport. The energies of the plant breeder have been largely bent in the direction of discovering early-maturing varieties.

The answer to the fundamental question, "Can wheat be grown in the West at all?" was found in 1840 after some devastating experiences, in a chance packet of wheat from Scotland, from which sprang the famous Red Fife, which was destined to cover the whole of the West. This saved the situation and left no doubt that the settlers could provide for their own sustenance, but an earlier maturing variety was still required, especially for export purposes. In 1903 Dr. Charles Saunders planted an experimental plot at the Dominion Experimental Farm at Ottawa with a haphazard cross between Red Fife and Hard Red Calcutta, and from this plot has sprung the Marquis wheat, which matures earlier, and yields better than Red Fife, and which has practically displaced all other varieties. In 1923, 500 million bushels of Marquis, all of which originated from a single seed on Dr. Saunder's plot, were raised on the North American continent.

This is a large figure, but even so the average yield of wheat in Canada stands in the neighbourhood of 17 bushels to the acre, as compared with 31 in this country. This is to be explained in part by a climate which only allows of spring-sown wheat. It is true that winter wheat can be grown in some localities, but the acreage devoted to it only represents two-fifths of 1 per cent. of the whole wheat acreage. Even so there is no doubt that the spring wheat yields can and will be increased in the future, as they have been in the past, and in this connection it will be interesting to follow the career of the Reward wheat, which has just been derived from Marquis at the Dominion Farm, and which gives every promise of being a distinct improvement on it.

Other difficulties connected with wheat-growing arise from drying winds, early autumnal frosts, hailstorms and particularly

from the depredations of the black stem rust, a disease which mercifully is unknown in this country, but which causes incalculable losses in the West. Could the scientists evolve a strain immune to this pest, as they have hopes of doing, the yield of the prairies would be vastly increased without further expense.

Machinery.—As far as machinery is concerned, it is probable that no sweeping improvement is to be expected, at any rate, in the near future. Canadian thrashing drums can sometimes cope with 2,000 bushels a day, which is a fair indication of the general efficiency that has been reached on the farm, when contrasted with a normal of some 400 bushels in this country; whilst at Montreal, the foremost grain port of the world (beating New York by 40 million bushels in 1923), a new elevator is in course of erection, into which it will be possible to unload two lake boats at once, each at the rate of 30,000 bushels an hour. Machinery capable of such performances would hardly seem to require much improvement.

An advance which is still sometimes advocated is that the Canadian farmer should adopt the harvesting machine, known as the stripper, which is used to such good effect in Australia and the Argentine, where only the heads of the wheat are cut off, and much stooking and lifting is avoided by the same machine thrashing the grain as it goes along. Such a machine, however, is out of the question for use in Canada, though large numbers are made there for export, owing to there being too much humidity in the atmosphere to allow the bagging of the grain until it has been dried to some extent in the field.

In the matter of agricultural machinery, Canada, as a new country, has been the pioneer, and any future improvements in her methods are not likely to be introduced from other countries, but will be evolved within her own borders.

Marketing.—At present practically all the wheat for export finds its way out of the country by means of the Great Lakes and the River St. Lawrence, and this route is closed in winter by ice. With the opening of the already partly constructed railway line to Port Nelson on the shores of Hudson Bay, whereby the route to Liverpool will be shortened by almost 1,000 miles, the congestion will be relieved to some extent, but this route also will be closed by ice in winter. Hence it is not unlikely that considerable competition will result from the development of Vancouver as a grain exporting centre. The completion of the Panama Canal has brought this seaport within reach of the harbours of the Old World, and her waters have the advantage

of being open all the year round. One of the most striking things to be seen at Vancouver is the loading of ships with cargo (though not, of course, with wheat) for direct sailing to Toronto. Already some 30 million bushels of wheat are shipped to Europe from the western port in the course of a year, and great preparations are in hand for increasing this trade.

The eastern harbours are fully alive to this new development, and are launching schemes for the improvement of the St. Lawrence, with a view eventually to making the lake-head ports available for ocean-going traffic, and thus eliminating the transhipment which at present has to take place at Montreal.

All these improvements will be much to the advantage of the prairie farmer, and in addition there are many other factors contributing to the betterment of his position. Among them reference may be made to the recent development of co-operative machinery for marketing farm products, a development which has been ably fostered by the Co-operation and Markets Branches of the Provincial Departments of Agriculture. The Canadian Wool-Growers' Co-operative Association has already been in existence for some three or four years, and the more recent co-operative elevator companies are now doing their part in enabling farmers to dictate the manner in which their grain is to be handled. Schemes for applying the same principles to dairy and other produce are meeting with success, and the one outstanding purpose underlying all these undertakings is to maintain the true spirit of co-operation, and to preclude the man with a mere financial interest from obtaining any hold on the business.

Agricultural Education.—Although the control of agricultural education is largely in the hands of the Provincial Governments, the provinces benefit by liberal grants from the Dominion Government for this purpose. For the last ten years and more about £200,000 a year has been distributed from Ottawa to this end, and we find great colleges and schools up and down the country, whose duty it is to teach the science of agriculture. The oldest of these was founded in Quebec in 1859, and there are now several others, of which that at Guelph, Ontario, including some 700 acres of land, is perhaps the best known.

Although the primary function of the agricultural colleges is to give training in the theory and practice of farming, provision is also made for conducting experimental work, and for publishing the results of such work.

The activities of the various institutions in this direction are supplemented by those of the Extension and Publicity Division of the Dominion Experimental Farms system, which, in addition to the printing and distributing of the records of experiments by pamphlets and through the Press, provides Illustration Stations to the number of nearly a hundred in different parts of the country. These are to be found on the land of representative farmers, who undertake to work according to instructions received from Ottawa, which are based on the results of the work of the experimental farms.

As far as the teaching side is concerned, great stress was at first laid upon the practical work carried out by the students, but opinion has veered round to such a degree that practically no outdoor work is now performed by them at the colleges, which are not regarded as being suitable for this class of instruction. Instead, the students are sent to commercial farms, where they work during the vacations, which are arranged to cover the best part of the year from this point of view. The colleges are in most cases attached to Provincial Universities, so that the college staffs can confine their activities to technical subjects, leaving the University to deal with the fundamental sciences, literature, sociology, and so forth.

A two-years' course at a college leads to a diploma, and a further two years to the degree of Bachelor of the Science of Agriculture (B.S.A.). At the schools a two-years' course is provided. Short courses are held in such subjects as dairying, seed and cattle judging, bee-keeping, fruit-growing, domestic science, etc. No college would be considered complete, which did not possess a cattle-judging arena, where the students sit round on raised benches, whilst cattle are exhibited in the ring by the instructors.

Even the Elementary Schools are well equipped to give an initial impetus to the study of agriculture by means of nature study classes and by school gardening, the teachers attending special courses at the colleges to prepare them for such work.

In addition to the experimental studies performed by the colleges, similar work is also undertaken by the 28 experimental farms and stations scattered throughout the country. These are all branches of the Dominion Experimental Farm at Ottawa, and are supervised from there by the director of experimental farms.

In spite of this generous provision for agricultural education, the scheme has not escaped several adverse criticisms. Sir John Russell has pointed out that agricultural science in Canada is

characteristically direct in its methods, and tends to leave the fundamental problems somewhat in the background. This is no doubt due to the fact that the work is almost all under the control of the Legislature, from whose point of view the direct attack is the most impressive. The defect is partly counterbalanced by the obvious advantages of centralisation, one such advantage being the provision against unnecessary duplication, a fault, which, in the opinion of some experts, is retarding agricultural progress all over the world. For the practical value of some of their experimental work, it would be hard to beat the record of the college at Guelph, in that the increased yields of barley, oats and winter wheat in Ontario, which are directly traceable to the work of that college, amount, at average market prices, to over 30 times as much as the net expenditure of the college since its foundation.

As far as the teaching is concerned, the colleges have been also criticised on the ground that they have failed to train men to be farmers, and thus to maintain a rural population. This is a very sweeping statement, and facts with which to meet it are hard to find, owing to that fluidity of the population to which reference has already been made, but it has been found that 54 per cent. of the past students of the Guelph College are now farming.

In conclusion, in Canada to-day we see a flourishing country, whose people have their eyes wide open to the almost limitless possibilities which lie before them, and whose purpose it is to be ready on all occasions to seize immediately every opportunity which offers of keeping pace with progress throughout the world.

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AGRICULTURAL COSTINGS IN SWITZERLAND AND DENMARK.

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II.—DENMARK.

SIMILAR work has been carried out in Denmark by Dr. Larsen since 1917, and the statistical data collected by him from the carefully kept accounts of more than 400 holdings of varying size have brought out the strong and weak points of the small holding system in a remarkable manner. It is only after carefully studying trustworthy data of this description that one can finally decide how far we, in England, should be justified in following the example of the Danes and adopting a policy

which involves the breaking up of the large estates. If such a policy is adopted, and the tendency certainly points that way, what size of holding is likely to give the best results for the nation as a whole and the individual farmer concerned?

If a time comes when we must, as far as possible, be self-supporting as far as our food supply is concerned, it is undoubtedly the small holding which is wanted. Dr. Larsen's figures answer that point conclusively.

TABLE IV.

Variation of Gross Output with Size of Farm. Average of Results, 1917 to 1923.

Size of Farm.	Gross output in pounds per acre. £	s.	d.
Under 25 acres	20	1	0
From 25 to 50 acres	15	4	0
,, 50 ,, 75 ,, ...	15	3	0
,, 75 ,, 100 ,, ...	13	18	0
,, 100 ,, 250 ,, ...	12	8	0
Over 250 acres	12	4	0

Is the time coming when we may lose our industrial supremacy, when the industries in the towns can no longer absorb our surplus population, and the question of employment of labour be one of the planks upon which a national agricultural policy will be built? The figures of Dr. Larsen will show that it is the small holding which, unit for unit, is socially in this respect the best.

TABLE V.

Size of Holding.	Wages paid per acre. £	s.	d.	No. of men employed per 100 acres. No.
Under 25 acres	8	12	0	11.3
25 to 50 ,, ...	5	15	0	7.8
50 ,, 75 ,, ...	5	10	0	7.0
75 ,, 100 ,, ...	5	2	0	6.5
100 ,, 250 ,, ...	4	2	0	5.4
Over 250 ,, ...	4	2	0	5.4

The individual farmer, however, will want to look at the matter from the personal point of view; the economic side rather than the social aspect of the matter will appeal to him. He has entered the business of farming as a business man, with him farming is a means to livelihood; he wants to pay high wages for his men; he wants to give employment to as many men as possible, but he must make a living, and it is here on the economic side that the figures of Dr. Larsen are so instructive, for they certainly do not reveal so conclusively the fact that the

small holding of approximately 20 acres, so common in Denmark, is the most economic unit. It is handicapped by high capitalisation, particularly in the form of non-productive capital; by high working costs, by the uneconomic employment of labour, both man and horse, to such an extent as almost, if not quite, to overbalance the social advantages it enjoys.

TABLE VI.
Capital Invested per Acre.

Size of Holdings.	Land.			Buildings.			Working Capital.			Total Capital.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Under 25 acres	16	10	0	18	8	0	20	12	0	55	10	0
25- 50 acres	17	5	0	13	5	0	15	8	0	45	18	0
50- 75 acres	19	3	0	12	4	0	14	15	0	46	2	0
75-100 acres	18	18	0	11	18	0	13	8	0	44	4	0
100-250 acres	18	10	0	9	18	0	11	10	0	39	18	0
Over 250 acres	19	8	0	10	2	0	10	7	0	39	17	0

When once the land has been acquired, buildings must be erected, and working capital found, before that land can be efficiently farmed. A glance at the table above will show that in the case of the small holding under 25 acres the total capital invested in the farm is approximately *three and a half* times the value of the land, and in the case of the holding of 250 acres roughly *twice* the value of the land.

It is unfortunate, too, that on small holdings such a large proportion of the capital is made up of non-productive capital in the form of buildings, implements and other dead stock, which are not likely to be put into circulation.

TABLE VII.
Nature of Capital.

Size of Holdings.	Capital per acre.									Percentage of capital in non-productive or non-liquid form.
	Non-productive.			Productive.			Total.			
	£	s.	d.	£	s.	d.	£	s.	d.	
Under 25 acres	23	2	0	32	8	0	55	10	0	42
25- 50 ,,	15	12	0	30	6	0	45	18	0	34
50- 75 ,,	15	4	0	30	18	0	46	2	0	33
75-100 ,,	14	10	0	29	14	0	44	4	0	33
100-250 ,,	12	0	0	27	18	0	39	18	0	30
Over-250 ,,	12	10	0	27	7	0	39	17	0	31

From the individual economic standpoint it is not so much the gross output that matters as the net; it is not the sales off the farm, its production or productivity that stands out as pre-

eminently important, but the margin between the production costs and prices realised on sale.

TABLE VIII.
Danish Results.

Size of Holdings.	Capital invested per acre.			Output per acre.			Cost of upkeep per acre.			Net balance per acre.			Normal interest on capital invested.			Balance per acre after allowing for normal interest on capital.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Under 25 acres	55	10	0	20	1	0	17	10	0	2	11	0	2	15	0	−0	4	0
25-50 acres	45	18	0	15	4	0	11	16	0	3	8	0	2	5	0	1	3	0
50-75 acres	46	2	0	15	3	0	11	10	0	3	13	0	2	6	0	1	7	0
75-100 acres	44	4	0	13	18	0	10	4	0	3	14	0	2	4	0	1	10	0
100-250 acres	39	18	0	12	8	0	9	5	0	3	3	0	2	0	0	1	3	0
Over 250 acres	39	17	0	12	4	0	9	4	0	3	0	0	2	0	0	1	0	0

In this respect there is, on broad general lines, an almost uniform agreement between the results obtained by Dr. Larsen in Denmark, Dr. Laur in Switzerland, and those which we have obtained from a more detailed study of a smaller number of farms in Yorkshire. In none of these cases is the small holding of 30 acres which is so common on the Continent found to be the most economic unit. After allowing for normal interest on the capital invested in the holding, and charging the labour of the small holder himself, at the normal rate paid to the hired man, there has been during the last seven years, an annual yearly deficit of 4s. per acre on the small holdings under 25 acres. The efficiency of the holding increased with its size up to a maximum which was reached on farms of between 75 and 100 acres, on which a surplus of 30s. per acre was obtained and then fell off steadily as the holding increased, the surplus on farms of over 250 acres being approximately £1 per acre.

The records of Dr. Laur show that if a man be placed on a holding of under 12½ acres, he would be £2 3s. 6d. an acre, or roughly 10s. a week better off were he employed as a hired man on a larger farm and were the money which he has sunk in his holding invested in Corporation or other Trustee Stock.

The records of Dr. Larsen show that if a man be placed on a holding of just under 25 acres, he would be 4s. an acre, £5 a year, or roughly 2s. a week, better off were he to hire himself out on a larger farm and invest his money again in Trustee Stock instead of in his holding. There are undoubtedly many

men so constituted that they would prefer to work for themselves, as their own masters, and order their own lives in their own way, rather than place themselves at the beck and call of another man, even if by so doing they were sacrificing something; and undoubtedly this spirit of independence is a thing to be encouraged and fostered.

A study of Dr. Larsen's figures shows that in Denmark, as in England, the small holder relies almost entirely upon the sales of produce of animal husbandry for his revenue.

TABLE IX.

Disposal of Produce Marketed.

Size of Holdings.	Sales per acre. Plant products.	Products of animal husbandry.	Other sales.	Total.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Under 25 acres	0 18 2	15 5 10	1 9 6	17 13 6
25- 50 ,,	1 1 9	10 5 10	0 11 8	11 19 3
50- 75 ,,	1 18 3	9 14 8	0 12 0	12 4 11
75-100 ,,	1 18 5	8 12 10	0 11 1	11 2 4
100-250 ,,	2 0 0	6 15 0	0 9 10	9 4 10
Over 200 ,,	4 8 7	4 14 9	0 12 4	9 15 8

Evidently he manages his grass land *better*, and his arable land, particularly the area under corn, *worse* than his brother on a large holding, as can be seen from the following records extracted from Dr. Larsen's figures.

TABLE X.

	Yield of Grain per Acre. Cwt.	Food Units of Grass and Forage Crops per Acre.
Under 25 acres	16.2	1,080
25 to 50 acres	16.8	965
50 to 75 acres ...	19.5	978
75 to 100 acres	20.2	840
100 to 250 acres	20.4	836
Over 250 acres	21.0	800

The skill of the small holder in the management of stock, the value of the individual attention which he is able to give to them—points which we have noticed in our own records on the farms which are being costed through the Leeds University Department in Yorkshire—are brought out by a study of Dr. Larsen's figures, as are also the handicaps that the small holder has to suffer in the overstocking of horses and the uneconomical use that can be made of the horse labour on holdings that are too small.

The following extract taken from a report sent off on 12th December, 1924, to L.C.A., a small holder farming 48 acres in the Doncaster area, may in this respect be of interest:—

"In many ways the holding at —— is handicapped in the same way as are the small holdings in Denmark and Switzerland. Possibly one of the most striking cases is the way in which it is heavily overstocked with horses, with the consequence that sufficient work cannot be found for them to keep them really busy on the farm. The following comparison of the efficiency of the horse labour on Mr. ——'s farm and on the 54 farms already referred to is certainly instructive.

TABLE XI.

	L. C. A.	Average of 54 farms.
No. of working horses kept per 100 acres ...	10	2.9
No. of working days per horse per year ...	54	148
No. of working horses kept per 100 acres of arable land...	14.3	5.7
Cost of horse labour per working day ..	10s.	4s. 10d.
Cost of upkeep per horse per year	£26 15s. 11¼d.	£35 15s. 4d.

In Denmark the really small holding of under 25 acres is nearly four times as heavily stocked with horses as is the large holding (for that country) of over 250 acres. The influence of the individual attention which can be given on the small holding is seen from the fact that on these holdings the food consumption and the total cost of upkeep have been reduced by nearly one-half. The fact that the horses on the small holdings cannot be kept busy is seen when it is realised that on the smallest holdings they worked for 94 days per head per year and on the largest for 212.

The skill in management of these men is shown by the fact that in spite of the small number of days the horses were working, the cost of horse labour was only eightpence per working day more than on the largest holdings which could keep horses busy.

The value of the individual attention that is given to stock by the small holder is seen from a study of Dr. Larsen's records of poultry and pigs (Tables XII and XIII). From these it will be seen that the small holder stocks his land heavily with birds (on the holding of under 25 acres possibly too heavily), watches his feeding remarkably closely, with a saving of 3s. per head, as compared to those on the holdings of over 250 acres, where the birds would be most probably looked after by hired labour; while the largest profits per bird and per pig were made on holdings in the one case just under and in the other just over 50 acres.

TABLE XII.
Poultry.

Size of Holding.	No. of birds kept per 100 acres.	EXPENDITURE PER HEAD. Food.	Labour.	Total.	PROFIT. Per Holding.	Per Acre.	Per Bird.
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Under 25 acres ...	294	0 8 0	0 2 4	0 10 1	9 0 0	1 12 0	0 4 11
25 to 50 acres	132	0 8 10	0 1 8	0 10 6	13 10 0	0 19 8	0 5 6
50 to 75 acres	122	0 9 10	0 1 9	0 11 7	17 0 0	0 14 0	0 4 6
75 to 100 acres... ..	72	0 10 2	0 2 1	0 12 3	13 0 0	0 7 6	0 4 2
100 to 250 acres ...	39	0 10 10	0 1 10	0 12 8	15 10 0	0 4 10	0 4 3
Over 250 acres	30	0 11 0	0 2 3	0 13 3	17 0 6	0 1 6	0 3 10

TABLE XIII.
Pigs.

Size of Holding.	No. of Food Units fed per pig.	PROPORTION OF FOOD FED Meal.	Milk or Whey.	Coarse Fodder.	Labour bill per pig.	Profit per pig.
		per cent.	per cent.	per cent.	£ s. d.	£ s. d.
Under 25 acres	509	62.6	22.5	15.9	0 19 6	0 12 2
25 to 50 acres	542	67.8	21.3	10.9	0 10 4	0 16 3
50 to 75 acres	530	74.8	19.2	6.0	0 8 4	1 8 6
75 to 100 acres	550	71.8	20.7	7.5	0 9 0	1 0 6
100 to 250 acres	574	71.7	20.1	8.2	0 9 10	0 13 2
Over 250 acres	618	75.8	17.8	6.4	0 13 0	0 3 6

IRIS DISEASES.

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THE group of Irises known as Bearded or Flag Irises, especially the section classed as Pogoniris Irises, which includes all the newer garden hybrids, are particularly liable to two forms of disease which, under certain conditions, may cause serious damage. These are "leaf-spot" or "leaf-blotch" and "rhizome rot," the one attacking the foliage and the other the thick, fleshy rootstocks, or rhizomes of the plants. In each case, whenever the attack is severe, complete destruction is effected. In addition to these two diseases a leaf-rust occasionally occurs.

Cultural Note.—Careful observations have led to the conclusion that the conditions under which the plants are grown together with the cultural practice, are factors influencing considerably their susceptibility to attacks by disease. It appears to be appropriate, therefore, to state briefly the methods of cultivation which experience has shown to yield the best results.

Situation.—Formerly it was thought by most people that the Genus Iris was a race of moisture-loving plants. However true that may be of such groups as the Japanese Irises (I. Kæmpfiri) and the English Irises (I. Xiphiodes), it is certainly not so as regards the bearded group.

All members of this group should be planted in a situation where, particularly as regards the latter part of the year, the maximum amount of sunshine is obtained, and where, also, there is least risk of permanent soil wetness or stagnation of any kind inducing acidity or sourness. For preference, the site should be a sloping bank or terrace, where efficient natural drainage is obtained. It cannot be too strongly emphasised that perfect drainage is of paramount importance, and in its absence sound growth and ripening of the rhizomes is impossible.

Soils.—With the possible exception of pure peat, most soils will grow the bearded irises, provided that where lime is naturally absent it is applied freely. Hence it is that ideal soils are found in the chalky loams. Clay loams, too, given good dressings of lime or chalk, will produce equally vigorous plants.

As regards cultivation, the most essential points are to see that the plants are taken up and replanted frequently—at least every three years—and to plant on deeply-worked soil. In planting it is important to keep the rhizomes as near the surface as possible,

so that their upper portions may be exposed to sun and air. Fresh manure should not be used on any account, and the importance of lime must be borne in mind constantly.

Experience shows that the best time to replant irises is immediately after the flowering season, and not, as is commonly believed, in the autumn or early spring. When the plants are to be brought in, or in other circumstances necessitating their partial drying off, it is advisable to defer planting till a month or so later.

Leaf-Spot or Leaf Blotch.—This disease was first noticed in this country in 1893. It usually becomes evident about the time of flowering, and spreads most rapidly during damp weather. In the early stages of attack, faint yellowish-brown spots appear on the leaves which become rapidly darker and more pronounced, so that in a very short time a clearly defined area of dead leaf tissue is distinguishable. These areas, when examined with a hand lens, will be found to bear minute black fruiting threads or conidiophores of a fungus, and on them multitudes of spores are produced, which are easily distributed by the wind and infect fresh leaves.

The disease spreads very rapidly, and the entire leaf blade soon becomes covered with spots which, spreading irregularly, merge into each other, and in consequence the leaf collapses and dies. If this continues unchecked, the whole of the foliage ceases to be of any material use to the plants, and they are as a result weakened considerably, apart from any question of general unsightliness of the attacked foliage.

The fungus is easily recognised by microscopical examination, owing to the characteristic appearance of its spores. They are elongated with rounded ends, and are divided by cross walls into two, three or more cells, each of which is capable on germination of sending out a germ tube which enters the iris leaf usually through a stoma. The surface of the spore is finely echinulate or spiny.

These spores are produced abundantly, especially in the summer and autumn, and are responsible for the spread of the disease. In mild climates they may also be produced during the winter, but only in small numbers. The fungus passes the winter in the form of mycelium or spawn in the old infected leaves, and in spring spores are again produced and distributed.

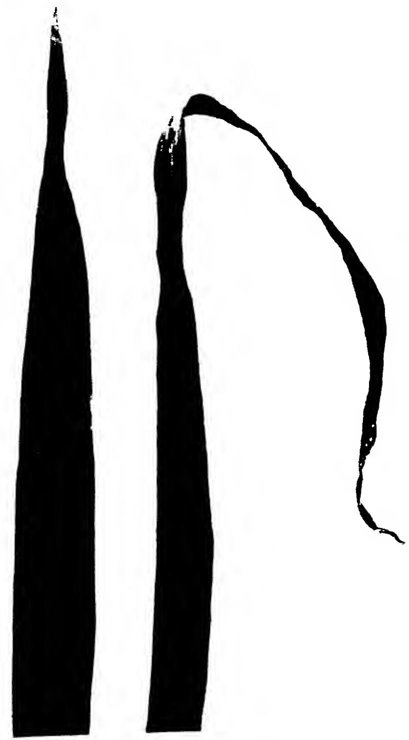
Recent investigations in Wisconsin, U.S.A., have shown that the fungus also produces in spring, on the old dead leaves, a perfect form of fructification. This consists of flask-shaped

structures (*perithecia*) containing sacs (*asci*) in each of which eight spores (*ascospores*) are developed. In some seasons, however, the *perithecia* remain barren, and they therefore cannot be absolutely essential for the continued existence of the fungus.

On account of the development of these *perithecia* it is now possible to name and classify the fungus more certainly. In the conidial or summer spore stage it was long known as *Heterosporium gracile* Sacc. It has now been shown on the grounds of priority and systematic nomenclature that it should in future bear the name *Didymellina iridis* (Desm.) v. Hoh. These changes in nomenclature are apt to be somewhat confusing, but they appear to be inevitable as systematic mycological knowledge evolves. The practical man need scarcely concern himself with them, but specialists will find full details of nomenclature and synonomy of this fungus discussed in papers by J. K. Ramsbottom (*Jour. Roy. Hort. Soc.*, Vol. XL, iii, April, 1915, p. 481) and W. B. Tisdale (*Phytopathology*, Vol. X, 1920, p. 148) respectively.

Control Measures.—This leaf spot or blotch is not a disease that can be got rid of by direct attack. Spraying has been attempted but has not given satisfactory results, doubtless partly because it is almost impossible to wet the glaucous, waxy foliage with a spray-fluid. Two points in particular have to be borne in mind. In the first place those plants are most prone to attack which are in an unhealthy condition owing to unfavourable soil and cultural conditions. Lack of lime is one of the commonest sources of want of vigour, and the application of phosphates has also proved to be beneficial. Superphosphate may be applied evenly and thinly in spring at the rate of from two to three ounces per square yard and worked into the soil. Basic slag, which supplies both lime and phosphate, may also be used similarly and in somewhat larger quantities.

The second point is that the parasitic fungus over-winters in the old affected leaves, and these alone are the means by which the disease is perpetuated. Careful and thorough removal and burning of the affected and dead leaves in the autumn has been proved, in the case of this disease, to be well worth while. At the same time, the ground should be dressed with slaked lime at the rate of about 2 lb. to the square yard. This should be worked in at once and removal of the plants is not necessary. This hygienic treatment of removing the sources of infection, combined with stimulation with lime, will result in the production of clean foliage in the spring, which will remain in this condition through the season.



Photos by] [*G. Dillistone.*

FIG. 1.—Showing the early stages of Iris Leaf Spot.

FIG. 2.—Iris Leaf Spot. Appearance of leaves when killed, showing spore-producing areas.

Rhizome Rot.—Particularly in the case of soils deficient in lime iris rhizomes frequently become attacked by a serious disease which takes the form of a soft pulpy rot of a most offensive nature. The first symptoms of its appearance are shown by the yellowing of a crown of leaves and their rapid collapse or by the falling over of a flower spike. Attacked rhizomes rapidly become a soft mass of decay, and unless this can be arrested the plants are destroyed.

This disease has been known for a considerable time and occurs both in Europe and America. It is known that the rot is caused by bacteria, and it seems that under varying conditions somewhat differing types or species are concerned. *Pseudomonas iridis* and *Bacillus omnivorous* are the names of two that have been described and studied in some detail, whilst recently Dr. Paine isolated from diseased rhizome material supplied by the Ministry's Pathological Laboratory an organism belonging, like the second mentioned above, to the *Bacillus carotovorus* group. In all cases the result of attack is that the middle lamella which normally binds the cells of the tissues of the rhizome together, is dissolved, and a pulpy more or less fœtid smelling mass results.

It is known that the disease is favoured by excessive wetness and also by shading, and such conditions should, therefore, be avoided. When the disease has taken a thorough hold of the plants, cure is almost impossible. In such cases they should be dug up and their remains destroyed by fire in order to render the infective material innocuous. The soil should be dressed with quicklime and not used again for planting irises for a time. In cases of slight attack the diseased portions may be carefully cut away and the knife used for so doing kept sterilised by frequent dipping into a suitable disinfectant, such as a solution of lysol. The trimmed rhizomes may then be dipped in a pink solution of permanganate of potash before replanting, the site having meanwhile been dressed with lime.

It is important that healthy plants only should be bought for planting, and upon the slightest sign of the disease being detected it is safest to dig up and destroy the affected plants, care being taken to remove and burn the surrounding soil. The site should then be dressed with fresh lime. Where a plant is only slightly attacked the diseased portion may be cut carefully away, and the healthy portion washed in a pink solution of potassium permanganate before it is replanted.

As in the case of leaf spot it has been found that where an effort is made to promote sound, healthy growth by application of lime and superphosphate the risk of damage by rhizome rot is lessened. The disease is most prevalent in wet seasons.

Rust.—Another disease of irises is the leaf rust caused by the fungus *Puccinia iridis*. This disease does not single out any particular group for attack, and is occasionally found on wild species in this country as well as on the various garden hybrids.

Small reddish or dark brown spots are scattered in more or less profusion over the leaves. They are from $\frac{1}{8}$ in. to $\frac{1}{4}$ in. long and about $\frac{1}{16}$ in. broad. They are usually surrounded by a paler coloured halo of diseased tissue. On the older spots greyish-brown blisters arise in the centre. Rupture of the skin eventually occurs, and a bright brown powdery mass of spores is thus exposed. These are the so-called summer spores, and their distribution results in the spread of infection and consequent development of new spots. Later on in the season a second kind of spore pustule is produced, particularly towards the bases of the leaves. The spores produced here are two-celled and have very thick walls. They serve to carry the fungus over the winter and on germination in spring produce a third form of spore from which infection occurs anew.

Further than the removal and burning of badly affected foliage no remedy is known for this rust, which, as a rule, is not of serious importance in gardens and nurseries. Beyond disfiguring the foliage, not much damage is done, since the plants are not seriously undermined in strength as is often the case with the leaf-spot disease described above.

* * * * * *

THE CUCKOO.

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THE advent of the cuckoo is probably one of the most eagerly anticipated events in Nature's calendar, and one realises with some surprise that, until comparatively recently, little was known of the life history of this most interesting bird.

So far as British ornithology is concerned, the cuckoo is unique, as it is the only species which maintains no nest of its own, but deposits its eggs in the nests of other small birds, leaving with the unfortunate owners the responsibility of rearing its offspring. It is remarkable that small birds should willingly rear the young of a bird twice or thrice their own size, and one can imagine

that the amount of labour entailed is colossal, especially with such a voracious feeder as a young cuckoo.

Economically, the cuckoo is in the main a useful bird, as its food consists chiefly of insects and their larvæ. It is one of the few birds that can comfortably digest such bristly propositions as the larva of the common tiger moth—the " woolly bear " so well known to children. It also eagerly devours the larvæ of the magpie and buff-tip moths, caterpillars that appear to be distasteful to many birds. On the adverse side must be set the fact that it is responsible for the destruction of a number of the young of other insectivorous birds.

The cuckoo usually arrives in this country during the second or third week in April, and leaves us in August or September. In the Home Counties, 15th April is probably the average date of arrival. In the writer's own district (North Kent), the bird has been first seen or heard on that date during the last two years, while in 1922 it arrived on 14th April, and in 1921 on the 16th. This year, however, a specimen appeared on 11th April. There are, of course, records of the bird's arrival during March, but such cases are exceptional. There is a good deal of evidence in support of the theory that the cuckoo is polyandrous, and during the breeding season females are frequently seen accompanied by two or even three males.

The majority of our female cuckoos commence to lay about the second week in May. Records of eggs during the first week in May are not numerous, and in April are extremely rare. The egg discovered by the writer in Essex on 26th April, 1924, is possibly the earliest authentic record of an egg in this country (see *British Birds*, Vol. XVIII, pp. 56 and 57). Other early records are those of Mr. H. S. B. Goldsmith, Somerset, 28th April, 1894 (*Zoologist*, 1894, p. 224), and Mr. A. W. Johnson, Berkshire, 29th April, 1912 (*British Birds*, Vol. VI, p. 18). There are also cases reported on 30th April, from Surrey (Mr. F. C. Selous), and Cheshire (Mr. F. S. Graves).

In our country, the species most frequently used as fosterers are the Meadow Pipit and the Hedge-sparrow, but many other birds are victimised. The full list is a formidable one, and it is sufficient to mention such species as the Redbreast, Tree Pipit, Pied Wagtail, Wren, Blackcap, Garden Warbler, Reed Warbler, Nightingale, Yellow Bunting, Reed Bunting and Whitethroat There are extraordinary records of cuckoos laying in the nests of such birds as the Ringdove and the Little Grebe, but as Mr. Frank Finn remarks, the birds responsible for these deposits

must have been acting on the principle of "any port in a storm."

The following is a summary of the cuckoos' eggs or young found by the writer during the years 1920 to 1924. Most of the species of fosterers mentioned may be regarded as common ones, but cuckoos do not frequently use the nests of Reed Buntings, and Chaffinches' nests but rarely.

	Hedge-sparrow	Meadow Pipit	Pied Wagtail	Redbreast	Chaffinch	Garden Warbler	White-throat	Reed Bunting	Total
1920	3	1	1	—	—	—	—	—	5
1921	4	3	1	1	—	—	—	—	9
1922	3	2	—	—	—	—	—	1	6
1923	4	1	1	—	—	1	1	—	8
1924	5	4	—	1	1	—	—	—	11
									39

The two eggs shown as having been found in 1923 in the nests of the Garden Warbler and Whitethroat are of particular interest, as they were found in nests situated within a hundred yards of each other, were identical in colour and marking, and were undoubtedly laid by the same cuckoo.

For many years ornithologists have been divided in opinion as to the method adopted by the cuckoo when depositing its egg in the nest of a fosterer. One side had it that the bird always laid its egg direct, *i.e.*, while sitting on the nest. The other contended that the egg was first laid upon the ground, and afterwards removed in the bird's bill to the selected nest. After years of patient study, Mr. Edgar Chance has established that in the case of nests of the open type, such as that of the Meadow Pipit, the former method is adopted, and that his discoveries in such cases leave no doubt, will be admitted by all who have seen his remarkable cinematograph records. It appears equally certain, however, that in some instances the cuckoo is compelled by force of circumstances to employ its bill. The writer has known several cases in which it would appear to have been impossible for the bird to have introduced its egg in any other way. There is, for example, a case in Essex where a young cuckoo was found in the nest of a pied wagtail. The nest was built in a hole in a brick wall. The cavity in which the nest was situated was fairly roomy, but the entrance was considerably less than two inches in diameter, and was about three inches in length. The surrounding brickwork had to be chipped away before the young cuckoo could be liberated. It is difficult to imagine how an adult cuckoo could have entered this hole for the purpose of laying an egg, and it is reasonable to assume that the bird, after laying the egg else-

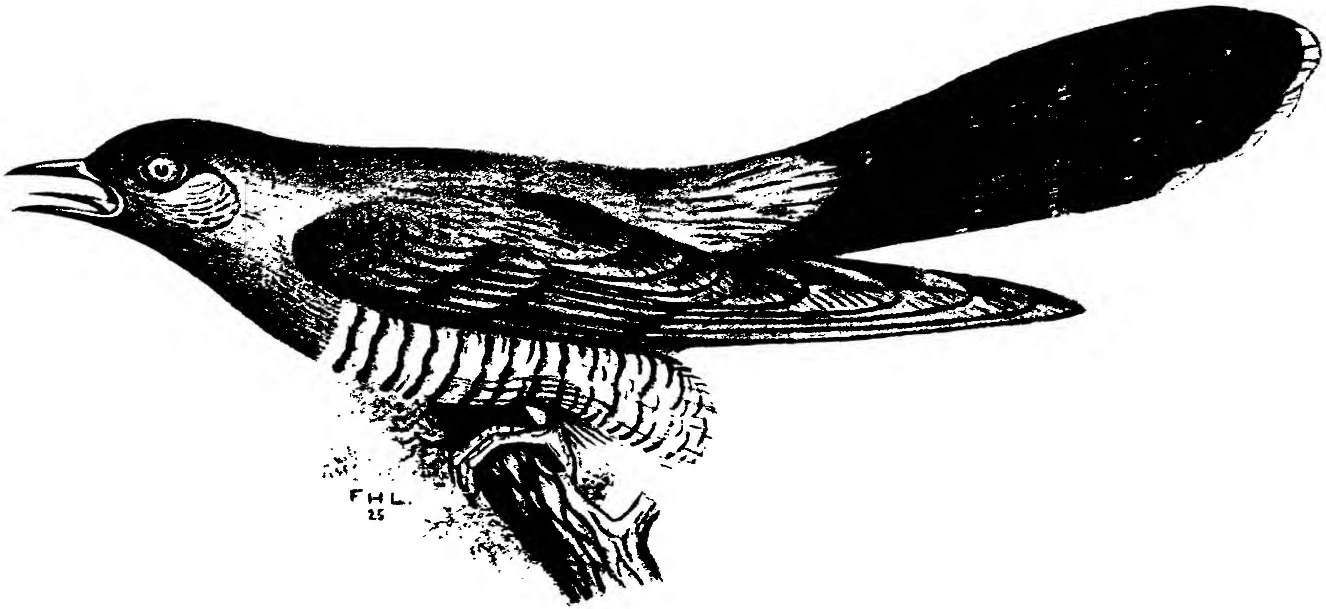

FIG. 1.—The Cuckoo.

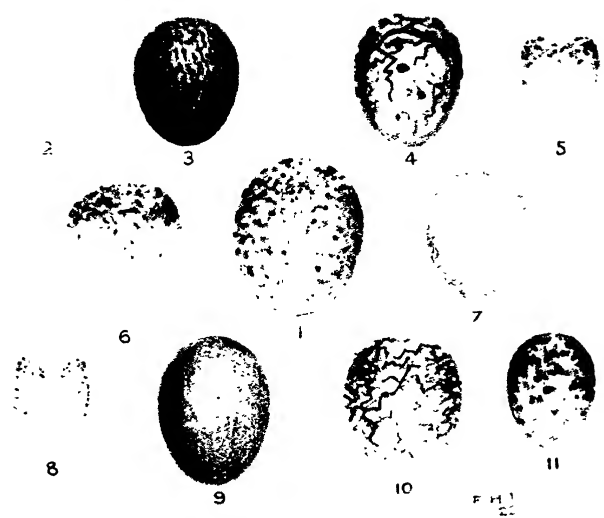

FIG. 2.—The Cuckoo's egg, together with eggs of foster birds

1. Cuckoo.
2. Goldcrest.
3. Meadow Pipit.
4. Reed Bunting.
5. Whitethroat.
6. Robin.
7. Hedge-sparrow.
4. Wren.
9. Nightingale.
10. Yellow Bunting
11. Reed Warbler.

where, inserted it with its bill. There is a somewhat similar case recorded from Berkshire, where a pied wagtail's nest, built in a narrow-necked pickle jar, was found to harbour a young cuckoo.

Mention may be made of another interesting case from the writer's own experience. In 1912, in South Essex, a redbreast's nest, built in an old stump, was found to contain two redbreast's eggs and one of the cuckoo. The stump was fourteen inches in height. The entrance hole was $1\frac{3}{8}$ in. diameter and about 6 in. from the top, which had been filled in. The nest was built on the ground inside the stump, roughly about 5 in. below the entrance hole. In this case the difficulties of direct laying would appear to be insuperable. Even if the cuckoo had deposited the egg in the nest with its bill, it probably had to be dropped an inch or two, and it is doubtful if any of the foster parent's eggs could have been removed.

The egg of the cuckoo is very small compared with the size of the bird, being very little larger than that of a house-sparrow. There appear to be two main types of cuckoos' eggs—one having a greenish-white ground spotted with dark ash, and the other having a buff ground, spotted with brown. There are, however, a number of intermediate varieties. The period of incubation is twelve days, or occasionally thirteen.

Usually, only one egg is placed in each nest, and the total number of eggs laid by one bird in a season is still uncertain; estimates vary from a dozen to twenty-five. Before depositing its egg, the bird generally removes one or more of the eggs of the rightful owners, and there is no doubt that eggs so removed are sometimes eaten by the cuckoo. At the same time, it must be mentioned that there are records of cuckoos laying in empty nests. The egg already referred to as being discovered by the writer on 26th April, 1924, was laid in an unfinished nest of the hedge-sparrow. On 17th May, this nest contained two young hedge-sparrows and one hedge-sparrow's addled egg. Other similar records are those of Mr. E. L. Wood, Harrow—cuckoo's egg in unfinished nest of the Goldcrest (*Zoologist*, Vol. XX, p. 275); and Mr. Pearce—one in an unfinished nest of the Reed Warbler (*Countryside*, 19th May, 1906). In the latter case, the warblers continued building after the cuckoo's egg had been deposited. On 17th June of this year, the writer, for the first time in his experience, found two cuckoos' eggs in the same nest (a hedge-sparrow's). These eggs were of entirely different types, and were obviously laid by different cuckoos.

The idea that the cuckoo lays its eggs with the object of matching in colour those of the fosterer is erroneous. The writer has seen some hundreds of cuckoos' eggs, *in situ* and in collections, but has rarely seen one that—quite apart from the question of size—could not readily be detected from the remainder of the clutch. It may be admitted that cuckoos using, say Pied Wagtails' nests will lay eggs conforming to a certain type or number of types, and that cuckoos using the nests of Meadow Pipits will lay eggs of quite different types, but this is no indication that such eggs are designed to imitate the eggs of the particular fosterer concerned. As already stated, it is usually not at all difficult to detect the cuckoo's egg in any clutch, and it is highly improbable that the bird has the power to vary the pattern of any of its eggs. Indeed, a series of eggs laid by any one cuckoo will be found to be identical in colour and marking.

The young cuckoo is a greedy and pugnacious little bird, and its habit of ejecting the eggs or young of the rightful owners is fairly well known. The actual process of ejection is very interesting to watch, and the young cuckoo appears to possess an almost inexhaustible store of energy, never ceasing in its efforts until the other occupants of the nest have been thrown out. Physically, it is well equipped for the purpose. If a very young cuckoo be examined, it will be noticed that it has a peculiarly hollowed back. The purpose of this hollow will be apparent when it is mentioned that the cuckoo, when ejecting another nestling, wriggles its way under the latter, and balancing itself with wings and legs, hoists its burden to the edge of the nest and ultimately over it. The writer once experimented in this direction. An ejected nestling was put back into the nest and again thrown out. The process was repeated five times during the day, after which the experimenter's patience proved inferior to that of the young cuckoo. The purpose behind this fury for ejection is not far to seek. With a bird of the size and appetite of a young cuckoo there would be literally no room for competition.

It is particularly noteworthy that a female cuckoo reared, let us say, in a hedge-sparrow's nest, will, when it comes to maturity, use hedge-sparrows' nests for the reception of its own eggs, and that unless the supply of the requisite fosterers' nests runs short, it will rarely use the nest of another species. Equally remarkable is the fact that a cuckoo will return year after year to the same locality, although this characteristic is shared by many other birds. It will be of interest to mention that a hen

cuckoo ringed by the writer as a nestling on Dartford Heath in 1922 returned to the same "pitch" in 1923, and again in 1924. This year, however, it has not put in an appearance. This particular bird used the nests of hedge-sparrows. In 1924 it had a certain amount of competition from another hen, probably one of its own progeny, but the latter was eventually driven away.

Although many points in connection with the life history of the cuckoo have been cleared up in recent years, there is still much to be done. Few birds are more interesting than this, which in many respects may still be termed the "bird of mystery."

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AUGUST ON THE FARM.

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Corn Harvest.—Owing to the hot, dry weather of June and July, corn crops this year began to ripen earlier than usual; some, the spring cereals on light land, or where sown late on heavier soils, may have ripened prematurely. According to present indications, harvest should be in full progress by the time these notes appear, provided that weather conditions are favourable. After such a summer, however, it would be unwarrantable optimism to expect long, dry periods in August, which has a high average rainfall and a reputation for making up any deficiency in the amount of rain received during the preceding two months.

The different stages through which corn passes in the ripening process were discussed in these notes last August, and, in particular, it was pointed out that with two exceptions the best stage for cutting is immediately the last tinge of green has gone out of the neck of the straw. The two exceptions were malting barley and autumn seed corn, which, in order to ensure even germination of the sample, should be allowed to reach the dead-ripe stage. Where there is delay in starting the corn harvest, there is usually difficulty in reaping the last fields in proper order; but rarely does one hear of regrets at commencing too soon.

In the days of hand reaping, each scythesman was followed by one woman to gather the grain and one man to bind the sheaves. The three could cut and tie about 1½ acres of wheat or 2 acres of spring corn in the day. Generally the raking up was

done by a boy, one to each two scythes. To make progress at the rate of 8 acres a day, a gang of about 15 workers was required. Corn was necessarily valuable and labour both cheap and plentiful in those times. The mechanical reaper began to be made use of about 1850, and although it left the grain in swathes it enabled one man operating the machine to perform the work of about six scythesmen; and, by liberating them for the duty of binding, it greatly accelerated the harvesting process. By the addition of sheafing attachments to the reaper, the women who previously gathered the grain were displaced, so that the hand labour required in the cornfield was reduced to half of the numbers employed in reaping with the scythe. The self-binder, introduced in 1879, enables one man to cut and tie 6 to 10 acres a day, more or less according to the condition of the crop and the soil and the haulage power available. It is perhaps when soil and crop conditions prevent the use of the binder that the modern farmer most fully realises his dependence on it, and the modern demand for stiff-strawed varieties of corn is one of the results of that dependence.

The side delivery reaper still has its uses. In humid districts, where it is desirable to leave the sheaves on the ground untied for a few days, this machine is popular. By dropping the sheaves out of the way of the team, cutting can proceed without the assistance of anyone to move the cut grain. Some farmers in such localities, however, make use of the self-binder, setting the binding attachment to tie comparatively small and loose sheaves. The reaper has the further advantages of lighter draught, suitability for uneven land and smaller initial cost. It has its adherents in the southern counties of England; but probably its most numerous users are found in France, where cheaper labour is available for tying and where the machine is also applied to the cutting of tall rye and tangled crops, such as lucerne, peas and buckwheat.

In good weather and with crops not containing much green bottom growth, it is hardly necessary to delay stooking; and even where it is considered necessary to allow the sheaves to lie on the ground for a time to expose the butts, the desired result may be obtained without the heads coming in contact with the soil; the sheaves can be arranged in fours to form a square, each sheaf having its heads lying on the butt end of the sheaf adjoining.

Catch Cropping.—The practice of growing catch crops is of most interest to the sheep farmer, and to him especially after his hay crops have mown light and when his prospects of roots

are not good. Also in districts where town dung was formerly depended upon for the maintenance of the humus content of the soil, catch cropping for the purpose of green manuring is attracting attention. Land available in August may be sown with white mustard, rape or hardy green turnips to produce autumn keep, or with rye, Italian rye-grass or thousand-headed kale for spring feed. Mustard and rye are probably the best where the object is green manure. Details respecting the seeding of each of these crops are given in the Ministry's Leaflet No. 392.

For the production of autumn feed or green manure, early sowing is of the greatest importance, as is illustrated by the saying that " a day in July is worth a week in August, and a week in August is worth a month in September." However, the condition of the land or the treatment given modify this. Unless the soil is in high condition, as after bare fallow or liberally manured early potatoes, the catch crop should receive a complete dressing of artificials at the time of sowing. It is well known that catch crops conserve nitrates that might otherwise be washed out of the soil in the winter drainage; nevertheless they themselves are greatly stimulated by soluble nitrogenous fertilisers.

Ordinary stubble catch-cropping is practicable only in favoured districts or exceptional seasons. In the southern counties and the districts warmed in winter by the Gulf Stream, hardy green turnips continue their growth through the winter, the mean daily temperature being above 40 deg. F.; whereas further inland and in the eastern counties the mid-winter temperature is normally below the above-mentioned figure and little growth takes place until about the end of February. Here, however, rye and rye-grass may sometimes be sown with considerable advantage on land that is intended for turnips, cabbage or marrow-stem kale in the following season. Suitably manured and seeded thickly in August or September, and top-dressed with nitrates in March, valuable grazing may be obtained in April or a good cut later in the month, both of which may be invaluable where the supply of roots is short. I have known this practice adopted with advantage on dairy farms in upland country; but admittedly it would be better in some respects to sow about 14 lb. of Italian rye-grass in the preceding spring under cover of the last corn crop.

Pasture Improvement.—Last September I gave details of the renovation of a tough, matted old pasture by ploughing up,

liming, etc., and seeding down again without cleaning the land or putting it through a rotation of crops. The success of the method depends on the power of wild white clover to suppress undesirable herbage, when conditions are made favourable to the growth of the clover by the application of lime and phosphates. An important aid in this direction, however, is the closeness with which stock graze young pastures laid down with modern simple mixtures. This fact is emphasised by the results of botanical examinations of the herbage of plots laid down by the Agricultural Department of Bangor University College at various centres in North Wales. Incidentally the difference in the persistence of wild and ordinary white clovers is strikingly demonstrated by the Bangor figures.* Doubtless the ploughing up method will be still more successful if the expectations regarding indigenous grasses are fulfilled.

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MONTHLY NOTES ON FEEDING STUFFS.

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Apple Pomace, its Composition, Digestibility and its Use in Practice.—*Origin.*—In the manufacture of cider, the cider apples, after removal of unsound apples, loose stones, dirt, etc., are pulped and filled into press cloths. These filled cloths are then placed in the cider press, and by means of heavy pressure the juice is extracted and pumped into the cider vats. The apple residue is known as apple pomace, a material that forms a useful by-product for feeding to stock. Where conditions are favourable, this product is fed in the wet condition, but under factory conditions it has been found desirable to dry the apple pomace —firstly in order to reduce transport costs, and secondly, to stop fermentation of the wet material. The method adopted in drying is to pass the wet pomace through a heated rotating cylinder,

* See this *Journal*, April, 1925, p. 13, "Improvement of Very Poor Pastures by Ploughing and Immediate Re-seeding."

the resultant dried pomace forming quite an attractive looking and pleasant smelling brown material. Apple pomace, like brewers' grains and sugar beet pulp, is therefore available to the farmer in two forms, as wet pomace and as dry pomace.

Composition of Dried Pomace.—Dried pomace, from an English source, is brownish in colour, and is sweetly acid in taste. An analysis showed the following composition. Moisture 8.3 per cent., fat 4.2 per cent., protein 7.1 per cent., fibre 16.3 per cent., carbohydrates 61.1 per cent. (containing 16.7 per cent. sugar), ash 3 per cent. Dried pomace is essentially a carbohydrate feeding stuff, and contains nearly 17 per cent. of free sugar. The ether extract contains waxes, gums and colouring matter in addition to true fat. In the sample analysed, there was present 2.7 per cent. true fat. About one-third of the nitrogen present is in the non-protein form. Dried pomace is deficient in lime, but contains a fair amount of phosphoric acid and potash, 100 lb. of dried pomace containing 0.26 lb. P_2O_5, and 0.51 lb. K_2O.

Digestibility.—*Approximate Value for purchase.*—The crude protein is 40 per cent., the crude fat is 67 per cent., the crude fibre 5 per cent., and the carbohydrates 70 per cent. digestible. Calculated on the above composition, the table of crude and digestible nutriments would be :—

Crude Nutrients.						Digestible Nutrients.						
Dry Matter	Crude Protein	Crude Fat	N. Free Ext.	Fibre	Protein	Crude Protein	Pure Protein	Dig. N. Free Ext.	Dig. Fibre	Dig. Fat	N. Ratio	S.E.
91.7	7.1	4.2	61.1	16.3	3.0	2.8	1.9	43.8	0.8	2.8	1.18	40.2

On the starch equivalent basis, with maize at 2s. a unit, dried pomace would be worth £4 a ton without allowing for the manurial value. With N. at 12s. 8d., P_2O at 4s., and K_2O. at 2s. 4d. a unit, the manurial value per ton of pomace would be 8s. 7d. Dried pomace would therefore be a reasonable purchase at £4 10s. a ton, with maize at 2s. a S.E. unit. With maize at 2s. 6d. a unit S.E., dried pomace would be a reasonable purchase at £5 10s. a ton.

Use of Wet Pomace.—Wet apple pomace is chiefly used in the west country. It appears to be used for all stock except pigs. In cider-making districts the common practice is to grind down enough apples to make a cider cheese, and immediately

DESCRIPTION.	Price per Qr. s. d.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv. s.	Price per lb. Starch Equiv. d	Percen. of Digest. Crude Protein %
Wheat, British	—	—	12 13	0 14	11 19	71·6	3/4	1·78	10·2
Barley, British Feeding	—	—	10 0	0 11	9 9	71	2/8	1·43	6·5
„ Canadian :—									
No. 3 Western	39/0	400	10 18	0 11	10 7	71	2/11	1·56	6·5
„ „ No. 4 „	38/3	„	10 15	0 11	10 4	71	2/10	1·52	6·5
„ American	39/0	„	10 18	0 11	10 7	71	2/11	1·56	6·5
„ Karachi	37/9	„	10 12	0 11	10 1	71	2/10	1·52	6·5
Oats, English, White	—	—	11 7	0 12	10 15	59·5	3/7	1·92	8·0
„ „ Black and Grey	—	—	10 10†	0 12	9 18	59·5	3/4	1·78	8·0
„ Canadian :—									
No. 2 Western	33/3	320	11 13	0 12	11 1	59·5	3/9	2·01	8·0
„ „ No. 3 „	31/9	„	11 2	0 12	10 10	59·5	3/6	1·87	8·0
„ „ Feed	27/3	„	9 10	0 12	8 18	59·5	3/0	1·61	8·0
Argentine	27/9	„	9 15	0 12	9 3	59·5	3/1	1·65	8·0
Chilian	28/0	„	9 17	0 12	9 5	59·5	3/1	1·65	8.0
Maize, Argentine	43/9	480	10 3	0 12	9 11	81	2/4	1·25	7·1
Beans, English Winter	—	—	12 0*	1 9	10 11	67	3/2	1·70	20·1
„ Chinese „	—	—	11 10	1 9	10 1	67	3/0	1·61	20·1
Peas, Japanese	—	—	24 15†	1 5	23 10	69	6/10	3·16	19·4
Dari, Egyptian	—	—	11 10	0 14	10 16	75·2	2/10	1·52	7·7
„ Persian	—	—	12 5	0 14	12 1	75 2	3/2	1·70	7·7
Millers' Offals :—									
Bran, British	—	—	6 12	1 4	5 8	45	2/5	1·29	10·9
„ Broad	—	—	8 5	1 4	7 1	45	3/2	1·70	10·9
Middlings—									
Fine Imported	—	—	9 2	1 0	8 2	72	2/3	1·20	12·6
Coarse, British	—	—	7 17	1 0	6 17	64	2 2	1·16	11·5
Pollards, Imported	—	—	7 0	1 4	5 16	60	1/11	1·03	11·6
Meal, Barley	—	—	12 0	0 11	11 9	71	3 3	1 74	6·5
„ Maize	—	—	11 10	0 12	10 18	81	2/8	1·43	7·1
„ „ South African	—	—	9 10	0 12	8 18	81	2/2	1·16	7·1
„ „ Germ	—	—	9 0	0 17	8 3	85·3	1/11	1·03	18·4
„ „ Gluten Feed	—	—	10 0	1 5	8 15	75·6	2/4	1·25	20·0
„ Locust Bean	—	—	9 15	0 8	9 7	71·4	2/6	1·34	4·0
„ Bean	—	—	13 0	1 9	11 11	67	3/1	1·65	20·1
„ Fish	—	—	19 10	3 17	15 13	53	5/11	3·17	50·0
Linseed	—	—	21 7	1 8	19 19	119	3/4	1·78	19·4
„ Cake, English 12% Oil	—	—	14 0	1 15	12 5	74	3/4	1·78	25·3
„ „ 10% Oil	—	—	13 5	1 15	11 10	74	3/1	1·65	25·3
„ „ 9% Oil	—	—	12 17	1 15	11 2	74	3/0	1·61	25·3
Soya Bean „ 6% Oil	—	—	12 5	2 8	9 17	69	2/10	1·52	38·2
Cottonseed Cake, English 5½% Oil	—	—	8 0	1 12	6 8	42	3/1	1·65	17·6
„ „ Egyptian 5½% Oil	—	—	7 15	1 12	6 3	42	2/11	1·56	17·6
Decorticated Cotton Seed Cake 7% Oil	—	—	12 17*	2 9	10 8	71	2/11	1·56	—
„ „ Meal 7% Oil	—	—	12 12*	2 9	10 3	74	2/9	1·47	36.3
Ground Nut Cake 7% Oil	—	—	10 10*	1 13	8 17	56·8	3/1	1·65	42·0
Palm Kernel Cake 6% Oil	—	—	8 10†	1 1	7 9	75	2/0	1·07	17·1
„ „ Meal 2% Oil	—	—	7 10	1 2	6 8	71·3	1/10	1·98	17·1
Feeding Treacle	—	—	7 2	0 8	6 14	51	2/8	1·43	1·1
Brewers' Grains :—									
Dried Ale	—	—	8 2	1 2	7 0	49	2/10	1·52	14·0
„ Porter	—	—	7 12	1 2	6 10	49	2/8	1·43	14·0
Wet Ale	—	—	0 17	0 8	0 9	15	–/7	0·31	4.8
„ Porter	—	—	0 13	0 8	0 5	15	–/4	0·19	4·8
Malt Culms	—	—	8 0†	1 11	6 9	43	3/0	1·61	19·9

† At Liverpool. * At Bristol.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of June and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 3s. per ton. The food value per ton is therefore £8 17s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices:—N, 11s. 7d; P_2O_5, 3s. 7d.; K_2O, 2s. 9d.

after the pressing is over, usually the second day after grinding, the cheese is hauled out into the fields for the cattle to pick it up at will. Occasionally wheat straw is used to bind the pomace in the pressing. Where the cattle are housed the pomace is crumbled and mixed with chaff and meals. The practice of one dairy farmer is to feed it to his milk cows to the extent of 20 lb. per head per day. Another farmer uses it for all stock, but principally milk cows and young cattle. The adult stock receive 12 lb. a head per day. In the autumn, the cows in milk generally get 10-12 lb. of pomace in the morning and 3 lb. of ground nut cake in the evening. From the beginning of December, rather less pomace is used, mixed with chaff and pulled swedes or mangolds; sharps, crushed oats and barley meal being given in addition. The fattening cattle also receive in addition 4 lb. of ground nut cake daily.

Method of Preservation.—In order to prevent fermentation it is usual to tread the pomace into large casks or tubs, water being added during the process, the object being to exclude the air. In this condition pomace will keep fresh for weeks. In one case, the farmer tried treading the pomace into a pit 14 ft. square dug 1 spit deep, watering as before, and covering with 4 in. of soil to exclude the air. In this way 18 tons of pomace were successfully preserved and eventually fed to stock, there being, however, an estimated wastage of 10 per cent.

Methods of Feeding Dried Pomace to Stock.—Dried pomace has been fed successfully in this country to cattle and sheep, both young and fattening and breeding stock, while American experience has shown that dried pomace can be used successfully for milking cows, the cows keeping in good flesh and milking well.

Use with Lambs and Sheep.—For fattening lambs on roots or kale, 1 lb. of pomace can be fed daily mixed with a little ground nut cake, the use of hay being dispensed with. For breeding ewes, when on grass, ½ lb. of pomace a day is sufficient to keep them in condition, but when grass and food are scarce, an *ad lib.* ration of pomace can be given. Both the lambs and ewes keep in excellent condition when pomace is fed, and experience has shown that no ill effects follow when the use of hay is dispensed with.

Use with Cattle.—In the case of cattle it is advisable to begin feeding pomace to calves at six months old, feeding not more

than ½ lb. of pomace per head per day at the start, gradually increasing the quantity until as bullocks they are getting 5 lb. a day. It is usually fed mixed with roots, and when roots are plentiful it is possible to feed more than 5 lb. a day. In Herefordshire, breeding cattle lying out are given up to 6 lb. a day, with straw in addition under severe climatic conditions.

Milch Cows.—American experience has shown that dried pomace can be successfully used. From a feeding standpoint it approximates in feeding value to that of dried beet slices. Milch cows fed on dried pomace continued in good flesh and milked well. It is best fed mixed with other concentrates, and up to 5 lb. per day can be given.

Necessity of Care in Feeding.—Both in the case of sheep and cattle care must be taken to feed the pomace dry, since it has been found that the stock will not touch the pomace if it has been allowed to become wet through rain. In wet weather, therefore, only sufficient pomace should be given as can be eaten immediately, or protection from the rain must be arranged for the feeding troughs.

FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat	1·25	2 4	71·6	8 7	0 14	9 1
Oats	1·25	2 4	59·5	6 19	0 12	7 11
Barley	1·25	2 4	71·0	8 6	0 11	8 17
Potatoes	1·25	2 4	18·0	2 2	0 3	2 5
Swedes	1·25	2 4	7·0	0 16	0 2	0 18
Mangolds	1·25	2 4	6·0	0 14	0 2	0 16
Beans	1·25	2 4	67·0	7 16	1 9	9 5
Good Meadow Hay	1·52	2 10	31·0	4 8	0 13	5 1
Good Oat Straw	1·52	2 10	17·0	2 8	0 7	2 15
Good Clover Hay	1·52	2 10	32·0	4 11	0 19	5 10
Vetch and Oat Silage	1·39	2 7	14·0	1 16	0 7	2 3
Barley Straw	1·52	2 10	19·5	2 15	0 6	3 1
Wheat Straw	1·52	2 10	11·0	1 11	0 4	1 15
Bean Straw	1·52	2 10	19·0	2 14	0 9	3 3

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	Average Price per ton during week ending July 15th.				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	13. 2	13 .0	12.10	12.15	16. 5
„ „ Lime (N. 13 per cent.)	...	12.10	...	12.12	19. 5
Sulphate of Ammonia, neutral (N. 21.1 per cent.)	12. 5*	12. 5*	12. 5*	12. 5*	(N)11. 7
Kainit (Pot. 20 per cent.)	3. 2	3. 0	...	...	...
„ (Pot. 14 per cent.)	2.17	2.15	2. 5	...	...
Potash Salts (Pot. 30 per cent.)	...	...	2.10	...	...
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7.10	7. 2	...	...
Sulphate of Potash (Pot. 48 per cent.) ...	12.10	11.15	11. 5	...	...
Basic Slag (T.P. 30 per cent.)	3. 3§	...	..	2.15§	1.10
„ „ (T.P. 28 per cent.)	2.10§	2. 5§	...	2.10§	1. 9
„ „ (T.P. 26 per cent.)	2. 6§	2. 1§	...	2. 5§	1. 9
„ „ (T.P. 24 per cent.)	...	1.17§	1.18§	...	...
Superphosphate (S.P. 35 per cent.) ...	...	...	3.15	3. 8	1.11
„ (S.P. 30 per cent.) ...	...	3. 2	3. 8	3. 2	2. 1
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	8.15	8. 5	7.17	7.17	...
Steamed Bone Flour (N. ¾, T.P. 60-65 per cent.)	6. 2†	6.10†	6. 5	5.10†	...
Fish Guano (N. 7½-8½, T.P. 16-20 per cent.)	...	...	13. 0	...	...
„ „ (N. 9, T.P. 10 per cent.) ..	...	...	...	12. 5	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station. London prices are for 4-ton lots.

§ Prices include cost of carriage from works to town named, and at Bristol and London are for not less than 4-ton lots. Hull prices include delivery to any station in Yorkshire, and Liverpool to any station in Lancashire; London prices include delivery within a limited area. Cost to purchasers in other districts will be greater or less according to the distances of different purchasers from the works.

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MISCELLANEOUS NOTES.

Bee Convention at Sparsholt Farm Institute.

A MOST successful gathering of bee-keepers was held on 20th June under the auspices of the Wilts, Hants and Dorset Bee-keepers' Council at the Farm Institute, Sparsholt, Winchester, by invitation of the Hampshire County Council. Some 250 bee-keepers from the neighbouring counties attended.

Mr. C. J. Gleed, Horticultural Instructor for Hants, gave an address on the subject of "Bees in Relation to Fruit Pollination." He stated that there was evidence that under normal conditions "sets" of fruit were much heavier where domestic

bees were kept in close proximity to fruit orchards, while "running-off" in black currants was less pronounced if bees, and particularly hive bees, were able to visit for the purposes of pollination and the extraction of nectar. Mention was made of the damage caused to bees through injudicious spraying with arsenate of lead during the spring.

After lunch, the party made a tour of the apiary which is maintained at the Institute by the Hampshire County Council. Mr. H. P. Young, Instructor in Bee-keeping for Hants and the officer in charge of the apiary, explained the working of the apiary and the part it had played in raising stocks and nuclei and distributing them to bee-keepers in the county. He demonstrated various types of hives in which the bees were seen to be working and explained in detail the advantages and disadvantages he had found in each. He also gave particulars of the experiments with new appliances which are being conducted in the apiary.

Subsequently Mr. Herrod-Hempsall, Technical Adviser in Bee-keeping to the Ministry, gave a lecture on "Advanced Bee-keeping," in the course of which he dealt with methods of manipulation, honey production, strains and races of bees, and other matters of interest and importance.

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THE following note has been received from Dr. J. Augustus Voelcker, Consulting Chemist to the Royal Agricultural Society:—

Farmyard Manure made under Cover and in the Open.

As showing the value of making and keeping farmyard manure under cover as against allowing it to be in the open, exposed to rain, etc., the following comparison obtained at the Woburn Experimental Farm may be found useful.

During the winter of 1922 cattle were regularly fed, on cake, roots, hay, etc., in a yard which is about three-parts covered, the remainder being exposed. The manure—plentiful litter being supplied—was allowed to accumulate, and then carted out in June, 1923, for potatoes, roots, etc. In the spring of 1924 samples of part of the manure which had not been carted out for use in the previous summer were taken from different parts of the yard, and analyses of average samples of these gave the following results:—

	Nitrogen. Per cent.	*Moisture. Per cent.*
From uncovered part	0.505	78.75
From covered part	0.913	71.52

The figures show in a marked degree the advantages of making and storing under cover.

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Extension of Small Holdings in Denmark.

A DANISH law, dated 29th March, 1924, provides for assistance to agriculturists who desire to purchase small holdings. Persons eligible for such assistance comprise agriculturists, horticulturists, agricultural labourers who have worked as such for the last five years, and allied workmen such as brick-makers, fishermen, etc. Approved applicants must first secure an offer of suitable land, or, if they cannot do so, may obtain the help of the communal council in finding land. The minimum area is 5 acres, but there is no maximum.

A local commission appointed for the purpose may then make a loan from State funds for the purchase of the land up to nine-tenths of its mortgage value. Taking the mortgage value, as is usual in this country, at two-thirds of the value of the land the loan would therefore amount to three-fifths of the whole. An additional loan is made for the erection of buildings, both loans bearing interest at 4½ per cent. For the first five years no repayment of principal is required and thereafter both loans are to be paid off by instalments over a long term of years.

The holding cannot be split up or combined with other land without the special consent of the Ministry of Agriculture, and it may only be transferred by the small holder to another, except a son, daughter, etc., if the new owner can also fulfil the conditions for approved applicants.

Provision is also made for loans for the extension of existing holdings, farm buildings, etc.

It will be observed that the provisions of the law are similar to those of Section 19 of the Small Holdings and Allotments Act, 1908, in force in this country, except that here a loan is only available for an applicant who is already the tenant of a holding and wishes to buy it.

Young Farmers' Clubs.

IT has already been stated in this *Journal* (April, 1925, p. 2) that the supervision of the Young Farmers' Club movement, which was initiated in this country under the auspices of the *Daily Mail*, has now been undertaken by the Ministry. The Ministry hopes that, in course of time, a practical interest in the formation and guidance of these clubs will become a recognised part of the agricultural education schemes of Local Education Authorities.

Club work is open to boys and girls of the age of ten years and upwards. Its main purpose is to stimulate in them a love for rural pursuits. Incidentally, it should give them a little acquaintance with the business side of agriculture and horticulture, and so provide a foundation for the more practical study of those subjects which they may, if they so desire, take up in future years. Again, in so far as the boys and girls may be the children of agriculturists, the formation of clubs often affords a means by which members of County agricultural staffs may secure the interest of the parents; such, at any rate, is the experience of Agricultural Organisers (County Agents) in the United States, where the movement has been taken up with enthusiasm.

The Ministry recognises that the initiation of a club must largely rest with some local resident, who is attracted by the project and is able to devote to it some time and energy, but trusts that Agricultural Organisers and other members of County Agricultural staffs will be able, as far as the limited time at their disposal allows, to help in this work and to assist the members of clubs with advice and lectures from time to time.

The Ministry feels that the Clubs should be autonomous, and should look to private sources for any initial help that may be required for the provision of stock, seeds, etc. Experience seems to show that there is little difficulty in obtaining from such sources the small loans necessary.

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Young Farmers' Clubs: International Cattle-Judging Contest.

THE fourth annual International Cattle-Judging contest, between teams representing the Young Farmers' Clubs of the United States of America and England for the *Daily Mail* Gold Challenge Cup, took place on Friday, 17th July. The competition was of special interest, having been the first of its kind organised by the Ministry, which has this year officially taken over the organisation of the Young Farmers' Club movement. Mr. James Mackintosh (National Institute for Research in Dairying) was responsible for the admirable arrangements made in connection with the selection of the dairy stock to be judged. First a ring of four shorthorns was judged at the Reading University Farm at Shinfield. The competitors next drove to Heron Farm at Pangbourne to judge a similar ring of Jersy cattle chosen from Dr. Watney's fine herd. The third ring was judged at Compton Farm, a selection being made of four Friesians from Mr. Barclay's stock.

Through the kindness of Mr. Barclay, luncheon and tea was provided in a marquee at Compton and the teams and visitors had an opportunity of inspecting the up-to-date premises there.

The judging was carried out by Mr. McCandlish, the Dairy Expert of the Glasgow and West of Scotland College of Agriculture, and Mr. Rushton, Principal of the Staffordshire Farm Institute. Mr. Weir, of the Canadian National Railway, acted as Umpire.

The teams were as follows:—

U.S.A.	Harlan Leonard Raymond Monahan Lester Olsen	Franklin County Dairy Calf Club, Iowa (Winners of the American Junior National Championship).
England	Dorothy Dean Ronald Knight	Northease Jersey Calf Club, Lewes, Sussex.
	Leslie White	Hemyock Calf Club, Devon.

The result in points out of 900 was as follows:—

America, 783. England, 755.

The order of merit was:—

Raymond Monahan (U.S.A.), 284 points.
Leslie White (England), 267 points.
Dorothy Dean (England), 265 points.
Harlan Leonard ((U.S.A.), 252 points.
Lester Olsen (U.S.A.), 247 points.
Ronald Knight (England), 223 points.

Farm Workers' Minimum Wages.

A MEETING of the Agricultural Wages Board was held on the 14th and 15th July, at 7, Whitehall Place, S.W.1, the Chairman, Lord Kenyon, presiding.

The Board considered notifications from Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and proceeded to make the following Orders carrying out the Committees' decisions.

Cambridgeshire and Isle of Ely.—An Order to operate as from the 20th July, fixing special rates of wages for employment on this year's corn harvest, the rate in the case of male workers aged 21 and over being 60s. per wk. of 64 hr. (excluding Sunday).

Dorset.—An Order continuing the current minimum and overtime rates of wages for male workers and the minimum rates for female workers until the 27th Feb., 1926, and fixing as from 20th July an overtime rate for female workers of 15 years and over. The weekly rates in the case of male workers aged 21 and over are 30s. per wk. of 51 hr., with overtime at 8d. per hr. In the case of females the rate for workers aged 15 and over is 5d. per hr., with overtime at 6d. per hr.

Essex.—An Order to operate as from the 20th July, fixing special rates of wages for employment on this year's corn harvest. The Order provides that male workers employed throughout the harvest on farms comprising more than 60 acres of corn shall be paid the ordinary minimum weekly rate, plus a bonus on completion of the harvest, which in the case of a worker aged 21 and over is £5 5s. 0d. In the case of male workers on such farms not employed fully on harvest, only a proportionate part of the bonus is payable. On farms comprising 60 acres or less of corn, male workers are to be paid at special hourly rates for all employment on harvest, the rate in the case of workers aged 21 and over being 10½d. per hr.

In the case of female workers, all employment on corn harvest is to be paid at special hourly rates, the rate for workers aged 21 and over being 7½d. per hr.

Norfolk.—An Order to operate as from the 20th July, fixing special rates of wages for the employment of male workers on this year's corn harvest. In the case of workers employed for the full harvest an inclusive wage is fixed to cover the harvest month, the amount in the case of workers aged 21 and over being £12. In the case of workers who do not work the full harvest the Order provides that they should be paid at the ordinary minimum rate with overtime payment at a special rate, which means that a worker aged 21 and over would receive the ordinary minimum rate of 29s. for a week of 50 hr., and for any extra hours worked 9½d. per hr.

Suffolk.—1. An Order amending the wording of the clause dealing with the guaranteed weekly wage for regular workers in the current Order, fixing minimum and overtime rates for male workers.

2. An Order to operate as from the 20th July, fixing special rates of wages for male workers employed on this year's corn

harvest. The Order provides that workers employed throughout the harvest on harvest work shall be paid, in addition to the ordinary weekly minimum rates, a bonus on completion of the harvest, the amount in the case of workers aged 21 and over being £6 3s. 4d. Provision is also made for the payment of a due proportion of the bonus to workers employed for only part of the harvest.

East Riding of Yorkshire.—An Order to operate as from the 20th July, fixing special overtime rates of wages for male and female workers employed on this year's corn harvest in lieu of the ordinary overtime rates. The special rate in the case of male workers aged 21 and over not boarded and lodged by the employer is 1s. 3d. per hr.; in the case of male workers boarded and lodged by the employer: foremen, waggoners, beastmen and shepherds, 1s. per hr.; lads 9d. per hr. and beginners 7d. per hr. The special rate for female workers under the Order is, in the case of workers aged 16 and over, 11d. per hr.

Copies of the Orders in full can be obtained on application to the Secretary of the Agricultural Wages Board.

Particulars of other Orders already made with regard to harvest rates of wages will be found in the issues of the *Journal* for June and July.

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Foot-and-Mouth Disease.—An outbreak of foot-and-mouth disease was confirmed on 3rd July on premises at Ottringham, near Hull. There were on the infected place 9 cattle and 7 pigs, of which 6 cattle were found affected with the disease. The origin of the outbreak is obscure. The slaughter of the stock was completed on the same day.

The usual Order was made imposing restrictions on the movement of animals within that part of the East Riding of Yorkshire within a radius of about 15 miles from the infected place.

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Leaflets Issued by the Ministry.—Since the date of the list given on page 95 of the April, 1925, issue of the *Journal*, the following leaflets have been issued:—

New.—No. 106. The Cultivation of Nuts.
,, 124. Cultivation of the Vegetable Marrow.
,, 125. Cultivation (and Diseases and Pests) of Melons.

Re-written.—No. 353. Oats.

Revised.—No. 1. The Black Currant Mite.
,, 129. Winter Egg Production.
,, 282. Scheme for the Improvement of Live Stock.

Amended.—No. 101. Prevention of White Scour in Calves.
,, 383. Hints on Goat-keeping.
,, 286. Narcissus Flies.

Mortality among Sheep after Dipping.—The Ministry announced on 22nd July, that with the development of double-dipping for the eradication of Sheep Scab, reports had come to hand from one district of deaths among sheep due to the use of poisonous dips.

The Ministry, therefore, wishes to repeat the warning to sheep-owners, published in the Press, first in July, 1920, and in the Leaflet (No. A.63/T.A.) "New Responsibilities of Sheep Owners," which has been widely distributed by the Police during the past two years.

Where their sheep have to be dipped in pursuance of the Ministry's Orders twice within a period of 14 days all owners are advised that, for the sake of safety, poisonous dips should not be used for both dippings. In cases where an owner prefers to select a poisonous dip for the first dipping, the Ministry desires to warn him that deaths may occur unless a non-poisonous dip is used for the second dipping. In cases where sheep-owners are prepared to run the risk of using arsenical dips for both dippings, the dip should be used at half its full strength for the second dipping. The Ministry takes no responsibility for any consequences which may arise from the selection of a poisonous dip. Farmers have the choice of a large number of effective non-poisonous dips.

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QUESTIONS IN PARLIAMENT.

Loans for Purchase of Farms.—In reply to a question in the House of Commons on 8th July, Mr. Guinness, on behalf of the Minister of Agriculture and Fisheries, stated that the Public Works Loan Commissioners, under the powers conferred on them by Section 1 of the Agricultural Credits Act, 1923, have advanced to farmers 638 loans, amounting to £2,545,946. The loans are repayable with interest at 5 per cent. per annum over varying periods not exceeding 60 years.

Agricultural Wages Act Prosecutions.—Colonel Day asked the Minister of Agriculture and Fisheries in the House of Commons, on 20th July, the number of prosecutions that have taken place for failure to pay the minimum rate of wage prescribed under the Agricultural Wages Act and the number of convictions secured, together with the amount of arrears ordered by magistrates to be paid?

Mr. Wood replied: I have authorised prosecutions in 11 cases, two of which have already taken place, and convictions secured in both cases. The arrears of wages ordered to be paid were £11 19s. 2½d. and £2 8s.

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REPLIES TO CORRESPONDENTS.

Mushrooms.— P.W., referring to the cultivation of mushrooms in cellars and caves, states that it is a practice with some growers to add about 8 lb. sulphate of ammonia to each ton of horse manure. He had also tried watering the beds with a solution of common salt at the rate of about 1 oz. to the gallon. Both processes appear to increase the yield, and he asks the reason.

Reply: The whole subject of mushrooms is by no means an easy one and there does not appear to be any good experimental work on the subject.

Mushrooms, it must be remembered, are not green (chlorophyllous) plants, consequently it is the organic (carbon-containing) part of their food that is important. The spawn lives for the most part on the organic compounds in the manure, and the idea that the manure is of importance principally on account of the heat produced is not right. One could not go on indefinitely growing this spawn—which is really the plant's vegetative body—on a restricted quantity of horse manure, because the organic compounds required would be exhausted. Another factor to be remembered in this connection is that the spawn in process of growth produces decomposition products, the accumulation of which would probably eventually render the old manure toxic. Then there are the fungi parasitic on the mushrooms (*i.e.*, the fructifications which grow on the spawn), which sooner or later would prevent profitable culture, were not fresh manure used.

As regards the addition of artificial fertilisers, mushrooms, like other vegetable growths, require nitrogen, phosphates and other elements of nutrition, and it is highly probable that these would also aid in the decomposition of the manure used as the basis. You might, therefore, try sulphate of ammonia at the rate you mention, both alone (in addition to the organic manure) and also in conjunction with an equal weight of superphosphate.

You allude to the action of salt. We can only tentatively explain this, but cannot guarantee the correctness of the explanation. The addition of common salt—and of various salts—would increase the strength of the solution outside the hyphæ (threads) of spawn. This would make it more difficult for the spawn to absorb water. It would tend to be in a condition of "physiological dryness." Now, in such conditions of dryness, whether physiological or physical, plants, on the whole, respond in many cases by diminishing vegetative activity and increasing reproductive activity. The production of more reproductive bodies (*i.e.*, the mushrooms and the spores borne on them) on the addition of salt solution, may be a response of this nature. It is also possible that by adding salt solution to the old manure, the oxygen thereby introduced may account for a good deal of the increased activity described.

Eradication of Worms in Lawns.—A.B. asked for a non-poisonous substance to eradicate worms.

Reply: The formula for a home-made solution frequently used is 1 peck of fresh quicklime to 40 gallons of water. In preparation the lime is placed in the water and after slaking has completely taken place, the mixture is allowed to stand until the slaked lime has all settled at the bottom. The clear liquid from the top is then taken and is used to water the lawn.

Soapsuds watered on the grass have also been reported to be effective in bringing the worms to the top, when they can be brushed away.

Winter Moth.—G.B. inquired as to the possibility of working some substance into the soil round fruit trees for the purpose of killing the chrysalids of winter moths, as grease-banding had not been found satisfactory.

Reply: No chemical has yet been discovered which, when dug into the soil round fruit trees, has given satisfactory results for the destruction of the chrysalids of winter moths. It has, however, been found that where poultry can be penned in the orchards, the birds will search out and destroy a large proportion of the chrysalids.

Grease-banding sometimes fails on account of insufficient care being taken to make certain that the winter moth females are unable to creep under the bands or to obtain access to the trees by some other route—as, for instance, by means of stakes, or even garden implements left temporarily leaning against the trunks. It must also be remembered that grease-banding will only deal with winter moths and one or two closely allied species. It has, for instance, no effect on the various other caterpillars which feed upon the foliage of fruit trees or upon aphides, which are commonly known as "blight."

Calcium Cyanide as an Insecticide.—J.G.W. inquired as to the possibilities of this substance as an insecticide.

Reply: It would not appear that any work has been done in this country on the insecticidal properties of calcium cyanide. The only cyanide in general use here is the sodium salt, which has now practically replaced potassium cyanide for the fumigation of glasshouses.

Greenhouse White Fly.—A.H.S. asked for information on the destruction of the White Fly (or Snowy Fly), *Aleyrodes vaporariorum*, which was attacking tomatoes and cucumbers in a glasshouse.

Reply: A leaflet was enclosed describing the hydrocyanic acid gas method of fumigation for its control, also a memorandum on an alternative gas, viz., tetrachlorethane. The latter is occasionally used when it is not possible to employ the very poisonous hydrocyanic acid gas through the structure to be treated opening into a dwelling house. In certain circumstances, however, tetrachlorethane will occasionally damage some kinds of plants.

It is possible that the feathery white substances which were found under the leaves are the cast skins of the larvæ. The ova are generally laid in circles and a stalk penetrates from each one into the tissues of the leaf. The larvæ themselves have quite superficially somewhat the appearance of aphides. Undoubtedly the larval stage is the harmful one, but opinion, so far as observations have been made in this country and abroad, agrees that the adult insect is also capable of effecting damage. The difference appears to be that whereas the larvæ cannot remove their stylets from the tissues, the adult insects are able to do so.

Detailed information on the insect itself is contained in a paper giving a critical study in the *Annals of Applied Biology* for January, 1915. It is probably safe to say that the greenhouse white fly has been known as a pest for the last fifty years. It is said to have been introduced from America. The tomato, though much affected, is not its only foodplant. Almost all greenhouse subjects are attacked.

Woodlice. — R.W.L. inquired as to the best means of eradicating woodlice from a vegetable store.

Reply: It would be best to lay poisoned bait for the woodlice. The following formula has emerged from some recent experiments as being the best for the purpose:—Oatmeal 50 parts, potassium bichromate 1 part, glucose 2 parts, water 30 parts.

It might also be convenient to provide alternative food to that the woodlice are destroying by using vegetables as traps. The most satisfactory for this purpose are red beet and mangolds. The roots should be cut in halves, with the cut sides placed downwards, the woodlice being collected every morning. This method has been found to maintain a quite satisfactory control.

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NOTES FOR THE MONTH.

Steam Cultivation.

FOR more than 50 years steam tackle has played a prominent part in tillage operations, and, in many parts of the country, more especially in the heavy-land, corn-growing districts, it still occupies first place in the farmer's estimation as an effective and expeditious means of preparing his land for crops.

An important part of the programme for increasing the country's food supplies during the war period was relegated to steam tackle. For this purpose one of the steps taken by the Food Production Department on its formation in January, 1917, was to mobilise the existing steam ploughing tackle and to provide for an increased supply at the earliest possible date.

Owing to difficulties of labour and lack of repair facilities, it was found that almost half of the 500 steam tackle sets in this country at the beginning of 1917 were not being used nearly as effectively as they should have been. These difficulties were overcome by the release from the Army of men experienced in steam tackle work, and by the provision of facilities for repairs, so that at the beginning of the summer of 1918 the whole of the 500 sets, excepting about 40 which were obsolete, were actually at work.

Sixty-five new sets of tackle were placed on order through the Ministry of Munitions with Messrs. J. Fowler, Ltd., of Leeds, and arrangements were made that they should be taken over by the Steam Cultivation Development Association for sale to members of that Association.

Each of these sets consisted of two 16-18 horse power engines, a 6-furrow plough, a trusser, an 11/13-tine cultivator, a water-cart, and a van complete with bedding for 6 men.

It was estimated that during the year 1918, 250,000 acres were ploughed, 880,000 acres were cultivated, and 23,000 acres were mole-drained by means of this scheme.

The decrease in the arable area in this country which followed the period of the War rendered it difficult for some of

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the steam tackle owners to keep their increased number of sets fully at work. During the present year, however, partly no doubt owing to weather conditions, steam ploughs appear to be more in demand than during the last three or four years.

Normally, steam tackle gets to work in dry weather in late spring, and continues throughout the summer and after harvest until wet weather stops it. Owing to unfavourable conditions up to the beginning of the recent dry spell, farmers found it impossible to deal with their fallows and there are, consequently, considerable arrears to be made up. During the fine weather hay-making and work among the roots occupied practically the whole time of all the labour available so that, in the absence of steam tackle, summer fallows could not receive the attention which every farmer knows they so well repay. Recently the corn harvest has been in full swing, and hay stubbles and corn stubbles will have to be dealt with, as well as the summer fallows, if full advantage is to be taken of the early season so as to get the winter corn sown in good time. It is in a season such as this that the use of steam tackle is so amply justified and so desirable. While the choice of a variety may make a difference in yield of 5 to 10 per cent., corn sown in September or by about the first week in October may yield anything up to 50 per cent. more than corn sown later in the year or in spring. Every week makes a difference.

In dry, settled weather the steam cultivator will speedily and efficiently produce a first-class fallow, but under rainy or unsettled conditions, and especially when dealing with a hay stubble, the steam plough is usually the better implement.

There is another important operation for which the steam cable system is pre-eminently suitable, namely, sub-soiling. Wherever there is a hard " pan "—and pans due to repeated horse-ploughing at the same depth, to deposits of iron compounds, etc., are of frequent occurrence—then this pan must be shattered before the soil will give of its best in all seasons. The predominant factors in plant growth are soil moisture and air; and the balance between the two must be properly adjusted.

Where a pan exists the soil is liable to become water-logged in wet weather, air is excluded and the plant languishes or dies. In such conditions plants are always shallow-rooted and as the top soil dries quickly in hot weather the crop soon begins to feel the effects of drought, for owing to the pan water cannot reach the plant from below.

When the pan is broken up both water and air can reach the lower layers, plants can enjoy a healthier and more extensive root-range and in times of drought water from below is accessible to them. In this connection too it is important to remember that when a plant, just like an animal, is in a position to make uninterrupted growth it is capable of resisting the attack of most diseases or pests.

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Report of the Fertilisers and Feeding Stuffs Advisory Committee.

THE presentation of the Report of the Fertilisers and Feeding Stuffs Advisory Committee (Cmd. 2470, price 9d. or $9\frac{1}{2}$d. post free), marks a further stage in the preparation of new legislation to replace the Fertilisers and Feeding Stuffs Act, 1906.

A Departmental Committee reported last year that a revision of the present Act is necessary, and outlined the method and extent of the control which should, in their opinion, be exercised over the trade in fertilisers and feeding stuffs. Further, they recommended that Schedules should be prepared showing the articles to which the new legislation should apply, and the nature of the particulars to be warranted in the case of each.

The formulation of these Schedules has been the principal part of the duties of the Advisory Committee, but recommendations have also been made on certain other points. The Committee are of opinion, for instance, that the time has come to cease official use of the expression "phosphates" in connection with fertilisers and to work in terms of phosphoric acid, as is usual on the Continent and elsewhere.

The Committee, of which Lord Clinton was Chairman, consisted of representatives of farmers and traders, agricultural and scientific advisers and nominees of the Ministry of Agriculture and Fisheries, the Board of Agriculture for Scotland and the County Councils' Association. As their Report is a unanimous one it is, perhaps, not too much to hope that the Committee's conclusions will meet with the substantial concurrence of all the many interests concerned.

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Farm Institute Courses.

A LEAFLET (Form No. 732/T.E.) showing the types of instruction which will be available at Farm Institutes during the session of 1925-6 has been issued by the Ministry. The leaflet gives the names of the farm institutes, a short description of the courses at each, the fees payable, either for tuition only, or for board, lodging and tuition, as the case may be, and the address to which inquiries for further particulars should be sent.

Copies may be obtained free of charge, and post free, on application to the Ministry, 10, Whitehall Place, London, S.W.1.

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Tuberculosis in Cattle: Disposal of Carcasses.

WITH a view to ensuring that the carcasses of animals slaughtered under the Tuberculosis Order of 1925 should not be disposed of for human consumption without adequate safeguards being designed for protecting public health, the Ministry of Agriculture has issued an Order providing that, in any case in which the carcass is intended to be used for human consumption, a copy of the notice of intended slaughter sent to the owner shall also be sent to the appropriate officer of the Sanitary Authority of the district, together with a statement of the address of the premises on which, and the time at which, it is intended to carry out the slaughter.

The Order also provides that in such cases the carcass, or any part of it, shall not be removed from the premises or be disposed of for human consumption, without the consent in writing of the Medical Officer of Health or other competent officer of the Sanitary Authority.

It is intended that a sufficient time should be allowed to elapse before slaughter to enable the Medical Officer of Health, or other competent officer, to be present at the post-mortem examination. At the same time, the Ministry trusts that such arrangements will be made as will ensure that the examination of the carcass is not delayed, since delay would prejudice the sale of any portion of the carcass which might be passed.

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Relief of Unemployment: Winter, 1925-26.

THE Ministry is now able to announce that His Majesty's Government have decided that the grants for Land Drainage schemes for the relief of unemployment, similar to those carried out during the past four winters, shall be continued during the coming autumn and winter.

The voluntary schemes will be conducted generally on the same lines as before through the agency of the County Agricultural Committees, but in view of the small sum of money available, it will not be possible to provide any grants towards drainage works in areas under the jurisdiction of a Drainage Authority.

As announced, however, in the House of Commons on 6th August, the Minister has under consideration proposals for a more permanent scheme of improvement by land drainage to be carried out by Drainage Authorities, but he is not yet in a position to put this into operation.

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Seed Potato Certificates.

FARMERS who think of selling seed potatoes must remember that it is necessary in the first place to get either a " Clean Land " or a " Purity " certificate from the Ministry. If the potatoes are of immune varieties, it is best to get a " Purity " certificate. These are issued after an inspection of the growing crop, and immediate application should be made to the Ministry, since the inspection cannot be undertaken after the haulm had died down. " Clean Land " certificates do not involve inspection except as regards crops grown in Wart Disease infected areas or near cases of the disease. If inspection is necessary, it must be made when the crop is being lifted and growers in the districts mentioned should apply early so that the necessary arrangements can be made.

All concerned with potato growing should remember that it is illegal to sell any potatoes for planting or to plant any purchased potatoes which are not the subject of either a " Clean Land " or a " Purity " certificate.

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Coloured Wall Diagrams of Plant Pests and Diseases.

To meet the need for good and technically correct diagrams of pests and diseases which attack agricultural and horticultural crops, the Ministry has produced the first four of a series of coloured wall diagrams. The subjects illustrated are:—(1) Apple Blossom Weevil; (2) Winter Moths; (3) Apple and Pear Scab, and (4) Silver Leaf. The diagrams measure 30 in. by 20 in. and are beautifully executed by the four-colour process. They are scientifically exact, attractive, clear and artistic. A reduced reproduction in black and white of the first of these is given herewith.

Of their kind, the diagrams now produced are unique, and should prove highly valuable to agricultural, horticultural and allotment societies; to Local Education Authorities for use in rural schools; to museums, colleges and public schools; to farmers and fruit growers; and to private individuals. The price of each diagram is 3s. unmounted, 5s. mounted and on rollers (post free). A descriptive leaflet is issued free with each diagram.

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Agricultural Scholarships and Agricultural Research Scholarships.

THE Ministry has awarded the following scholarships to post-graduate students:—

(1) For training as Agricultural Organiser, Lecturer, etc.:—

Name.	*Subject of Study.*
J. L. Davies, B.Sc. (Wales)	Agricultural Economics.
W. N. Jones, B Sc. (Wales)	Animal Husbandry.
A. Rowlands, B.Sc. (Wales)	Dairying.
(Miss) A. P. Wilson, B.Sc., A.R.C.Sc. (Lond.)	Diseases of Glasshouse Crops.

(2) For training as Agricultural Research Worker:—

Name.	*Subject of Study.*
W. M. Davies, B.Sc. (Wales)	Agricultural Entomology.
C. E. Marshall, B.Sc. (Manchester) ...	Soil Chemistry.
H. J. Meredith, B.Sc. (Wales)	Agricultural Economics.
B. G. Peters, B.Sc. (Bristol)	Agricultural Zoology.
E. L. Taylor, B.Sc., M.R.C.V.S., D.V.H. (L'pl.)	Veterinary Science.

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Fig. 1.—Reduced reproduction in black and white of coloured Wall Diagram No. 1.

The Agricultural Index Number.

THE general level of the prices of agricultural produce was further reduced during July, mainly as a result of the lower prices of wheat, fat sheep and potatoes. On the average agricultural produce was selling at 51 per cent. above the prices in July, 1911-13, this being a drop of 4 points on the month, and 19 points below the level of January last. In July last year the index number was 52 per cent. above pre-war, so that the rise which took place last autumn has now been lost.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.	1925
January ...	200	183	75	68	61	70
February ...	195	167	79	63	61	67
March ...	189	150	77	59	57	65
April ...	202	149	70	54	53	58
May ...	180	119	71	54	56	57
June ...	175	112	68	51	58	55
July ...	186	112	72	53	52	51
August ...	193	131	67	54	59	—
September	202	116	57	56	60	—
October ...	194	86	59	51	63	—
November	193	79	62	53	64	—
December	184	76	59	56	63	—

Wheat averaged 11d. per cwt. less than in June, and the average of 11s. 11d. per cwt. was exactly the same as in July last year. Barley was 1s. 4d. per cwt. cheaper than a year earlier, but oats were 5d. per cwt. dearer, both barley and oats being 34 per cent. above July, 1911-13, with wheat relatively dearer at 47 per cent. above.

Fat sheep declined by 1d. per lb. on the month, the index number being reduced from 93 per cent. above pre-war to 79 per cent. above, this being the lowest index figure for fat sheep since April, 1924. Fat cattle also became cheaper and, although a fall is usual in July, the decrease this year was relatively rather greater than in the basic years, and the index number declined by 2 points. Fat pigs were practically unchanged in price, but as there was a rise in July in the basic years the index numbers declined slightly.

The demand for dairy cows improved considerably when milk yields fell off owing to the dry state of the pastures, and prices advanced by £1 per head. The shortage of grass had the opposite effect with store cattle, which became very difficult

to sell and averaged 15s. per head less than in June. Store sheep still remained very dear at more than double pre-war prices. Young pigs at 53 per cent. above pre-war were at relatively much the same level as fat pigs.

The index number for milk advanced by 2 points owing to a slightly higher average price for contract milk delivered to Manchester, prices being unchanged at London and Birmingham. Butter rose sharply, the advance on the month being 2¾d. per lb., and at 73 per cent. above pre-war the index number was 13 points higher than in July last year. On the other hand cheese declined by 9s. 6d. per cwt., and at 70 per cent. above 1911-13 was 20 points lower than a year earlier. The rise of 3d. per dozen in egg prices was relatively sharper than in pre-war years, and the index figure advanced to 61 per cent. above July, 1911-13, but was slightly lower than last year.

The markets were fully supplied with early potatoes during July and prices were low, the average wholesale price being only £7 19s. per ton or £2 2s. 6d. per ton cheaper than last year, and only 43 per cent. dearer than in July, 1911-13. Hay prices have varied very little from month to month for some considerable time; during July prices were slightly lower than in the previous month.

Index numbers of different commodities during recent months and in July, 1923 and 1924, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

Commodity.	1923. July.	1924. July.	1925. April.	1925. May.	1925. June.	1925. July.
Wheat ...	39	47	62	59	62	47
Barley ...	12	52	38	36	38	34
Oats	41	28	34	36	38	34
Fat cattle ...	45	54	50	49	50	48
Fat sheep ...	72	97	100	100	93	79
Bacon pigs ...	49	31	68	60	54	51
Pork „ ...	59	31	67	60	53	52
Dairy cows ...	49	56	47	48	47	50
Store cattle ...	28	51	39	40	43	42
Store sheep ...	109	132	100	99	115	115
Store pigs ...	113	28	64	55	55	53
Eggs... ...	36	65	51	48	52	61
Poultry ...	79	80	50	55	61	75
Milk	57	50	58	55	55	57
Butter ...	37	60	64	54	57	73
Cheese ...	54	90	61	70	78	70
Potatoes ...	66	81	115	124	76	43
Hay	38	1	—2*	3	3	0

* Decrease.

LIVE STOCK IMPROVEMENT SCHEME.

REPORT FOR THE YEAR ENDED 31ST MARCH, 1925.

DURING the year ended 31st March, 1925, the Live Stock Improvement Scheme continued to operate on the usual lines described in previous reports, and on the whole satisfactory progress was made. Although the scheme has been in operation for eleven years there are still many districts in which, even if it has been heard of, the scheme has not yet been given a trial. This has been due, in some measure, to the difficulty of persuading a conservative industry to adopt new ideas or change its methods, and it is due also to the fact that the districts allotted to the Ministry's Live Stock Officers have been somewhat large. The recent appointment of additional officers and the revision of the districts into which the country is divided will, it is hoped, enable further progress to be made both in opening up fresh ground and in establishing the good work which has already been accomplished. The Live Stock Scheme comprises a great deal beyond interesting the farmer in the use of a good sire and, as regards his cows, in the keeping of milk records—which are the two main principles of the scheme. To educate the farmer so that the selection of good animals for breeding becomes not only a capability but a habit; to make suitable feeding an intelligent custom instead of a tedious theory; to foster a willingness to incur initial expenditure for the sake of ultimately better returns; in short, to demonstrate all the correlated requirements of "grading up," and the commercial soundness of them; these are objects which must take several years to accomplish, but toward which the Live Stock Scheme may fairly be said to be making good progress.

Bulls.—The Bull Scheme has continued to be popular, and with the relaxation of foot-and-mouth disease restrictions, which hampered development in the preceding year, satisfactory progress has been made.

The total number of bulls actually located for service during the year ended 31st March, 1925 (*i.e.*, continued from the previous year with renewed grants or provided for fresh districts during the year), was 1,069, an increase of 91 on the preceding year.

BULL SCHEME.

(Showing the Number of Bulls subsidised each Year since the Commencement of the Scheme.)

Year. 1st April—31st March.	*Societies.*	*Individuals.*	*Total No. of Bulls.*
1914-15*	369	43	497
1915-16	489	28	633
1916-17	543	15	659
1917-18	578	14	710
1918-19	604	7	721
1919-20	568	6	675
1920-21	561	6	668
1921-22	726	3	847
1922-23	831	1	947
1923-24	840	1	978
1924-25	916	1	1,069

The Bull Scheme is beginning to have a marked effect in districts where it has operated for some time. The improvement effected in the quality of stock reared continues to be proved at markets and sales, and the introduction of special classes at shows for premium bulls and their progeny is an encouraging recognition of the scheme. A good instance of this was provided at the Yorkshire Agricultural Society's Show in July, 1924, at York, where arrangements were made for a special class for premium bulls. Twenty bulls were entered and eighteen were shown. The class was reported as being very strong, not only as regards the number but also the quality of the bulls shown, and constituted in the opinion of many the most interesting feature of the show. Considerable interest was created among local breeders, and it was decided to provide for a similar class at the Society's next show. It is worthy of mention that three of the bulls shown were themselves the progeny of premium bulls. Another example was provided at an agricultural show at Bakewell, where a group class was organised in which premium bulls were shown with two each of their progeny. Nine such groups came before the judges, and this feature of the show was reported to be a great success.

The effect of these and other similar demonstrations of the quality of stock used under and produced by the scheme is considerably enhanced by the successes obtained by premium stock in the open classes at shows throughout the country. These happenings are not without effect on the minds of farmers who have not hitherto given the scheme a trial, and the Ministry's Live Stock Officers are able to report a growing interest in the selection of bulls used, often outside the scheme,

* Including the period 1st February, 1914—31st March, 1914.

and while in many districts there is still a regrettable lack of care in the breeding of live stock the conditions to-day as compared with those in existence before the inauguration of the scheme are, on the whole, distinctly promising. A further indication of an awakening interest in live-stock breeding and the use of a good sire may be found in the more frequent representations which are being made to the Ministry with regard to the question of eliminating the scrub bull. The Ministry is fully in sympathy with the object of these representations, and when it has sufficient agricultural support it will be prepared to proceed with the necessary legislation. Some such action would seem to be necessary in the future, as the Ministry's scheme, though it is doing good work in the desired direction, is very limited in its scope by reason of expense. The magnitude of the task will be easily appreciated when it is remembered that the number of bulls subsidised by the Ministry is about one thousand as compared with the total number of bulls in the country, estimated to be about 82,000.

Prices.—As will be seen from the following table the average price of bulls used under the scheme showed a small decrease on that of the previous year. The Shorthorn continues to be the most popular breed, and more than half the sires subsidised are of that breed.

NUMBERS AND PRICES OF BULLS OF EACH BREED.

Breed	1914-15		1923-24		1924-25	
	No.	Average Cost	No.	Average Cost	No.	Average Cost
		£ s. d.		£ s. d.		£ s. d.
Aberdeen-Angus	–	–	–	–	1	52 10 0
British-Friesian	–	–	5	74 16 0	6	53 14 0
Devon	16	40 17 6	106	57 16 0	115	58 11 0
Guernsey ...	–	–	12	51 10 0	13	47 13 0
Hereford ...	63	33 7 6	100	50 19 0	105	50 2 0
Lincoln Red ...	33	31 10 0	101	55 11 0	116	51 19 0
Red Poll ...	–	–	–	–	2	28 0 0
Shorthorn ...	337	37 17 0	573	57 10 0	593	55 5 0
South Devon ...	6	36 11 6	15	47 5 0	11	38 13 0
Sussex ...	–	–	–	–	1	44 2 0
Welsh Black ...	35	29 9 0	62	52 1 0	63	47 6 0
All Breeds ...	497*	36 0 0	974	56 3 0	1026†	53 18 0

* Including 7 "other breeds."

† 1,069 bulls were located, but grants in respect of 43 were in suspense at the end of the year.

Service Fees.—The service fees varied little from the previous year. About one-half of the bulls served at a fee of 5s., and the average service fee for all the bulls was the same as in the preceding year, viz., 5s. 3d.

Year	2/6	3/-	3/6	4/-	4/6	5/-	5/6	6/-	6/6	7/-	7/6	8/-	8/6	9/-	10/-	Over 10/-
1914-15	265	57	41	42	3	88	–	–	–	–	1	–	–	–	–	–
1923-24	51	46	25	71	9	491	2	84	2	12	126	6	7	1	26	5
1924-25	54	46	21	78	7	539	4	95	3	8	135	6	8	1	15	6

Boars.—Notwithstanding the slight increase shown in the number of boars available during the year ended 31st March, 1925 (*i.e.*, continued from the previous year with renewed grants or located in fresh districts during the year), the year was not on the whole a satisfactory one for pigs. In the first part of the year the drop in the price of pigs caused a reduction in breeding, and although the number of boars used under the Ministry's scheme has been maintained, Live Stock Officers report that the number of sows served has generally been below the average.

BOAR SCHEME.

(Showing the Number of Boars subsidised each Year since the Commencement of the Scheme.)

Year 1st April to 31st March	*Societies*	*Individuals*	*Total No. of Boars*
1914-15*	115	–	115
1915-16	180	–	193
1916-17	186	15	216
1917-18	172	92	264
1918-19	156	167	350
1919-20	120	225	399
1920-21	135	285	441
1921-22	113	416	550
1922-23	93	451	569
1923-24	78	541	638
1924-25	68	587	655

Fluctuations in pig breeding are probably less marked where the existence of a bacon factory renders the demand for suitable pigs more constant. In such districts a steady demand for a definite type tends to stabilise the industry both as regards the number and type of pig produced, while in many parts of the country some difficulty seems to exist among breeders in deciding on the type of pig that should be produced, and the type of boar that should be used. Local preferences for particular types (sometimes not recognised as distinct breeds by the Ministry) contribute not a little to the difficulty of developing this section of the Ministry's Live Stock Scheme.

* Including the period 1st February, 1914–31st March, 1914.

Toward the latter part of the year there were indications of a revival in pig breeding, and with it the demand for boars under the scheme will again revive.

Prices.—The most popular breeds continued to be Large White, Middle White and Large Black, although in the case of the Large Black pig there was a further and very noticeable drop. A similar decline is noted in connection with the Gloucestershire Old Spots breed. It will also be seen from the following table that the average prices paid for all breeds have slightly decreased :—

NUMBERS AND AVERAGE PRICES OF BOARS OF EACH BREED.

Breed	1914-15				1923-24				1924-25			
	No.	Average Price			No.	Average Price			No.	Average Price		
		£	s.	d.		£	s.	d.		£	s.	d.
Berks	10	8	0	0	10	17	1	9	15	13	3	5
Cumberland	—	—			29	14	5	3	33	12	9	4
Essex	—	—			5	19	9	9	4	18	2	9
Glos. Old Spot ...	7	7	1	0	32	15	8	3	22	14	18	3
Large Black	18	7	5	6	138	13	4	4	103	12	1	2
Large White	64	7	3	0	250	14	11	9	247	13	16	10
Lincoln Curly Coat ...	4	8	4	6	35	11	16	10	27	10	17	11
Middle White ...	12	6	17	0	98	14	16	9	111	14	5	0
Large White Ulster ...	—	—			6	16	6	8	7	15	19	3
Tamworth	—	—			2	18	18	6	2	18	2	0
Wessex Sandleback ...	—	—			14	14	12	6	22	13	5	7
Welsh	—	—			—	—			24	11	16	1
All Breeds	115	7	5	3	619	14	6	2	617*	13	8	1

Service Fees.—The service fees, ranging from 2s. 6d. to 10s. varied very little from the previous year. More than one-half the boars served at a fee of 5s., and the average fee for all the boars was 5s. 4d.

Year	2/-	2/6-	3/-	3/6-	4/-	4/6-	5/-	5/6-	6/-	6/6-	7/-	7/6-	8/-	8/6-	10/-
1914-15	21	62	10	5	6	—	2	—	—	—	—	—	—	—	—
1923-24	—	9	9	12	44	1	368	1	58	2	4	104	—	2	5
1924-25	—	9	10	14	45	4	371	2	52	3	2	100	—	1	4

Heavy Horses.—As stated in last year's Report, the decision to revive the grants to Heavy Horse Societies was made somewhat late, and in consequence full advantage could not be taken of the scheme for the service season of 1924. Particulars furnished to the Ministry in connection with applications for

* 655 Boars were located, but grants in respect of 38 were in suspense at the end of the year.

these grants served to show how adversely Heavy Horse Breeding had been affected during the period which followed the withdrawal of the Ministry's assistance. About eighty per cent. of the societies subsidised by the Ministry in 1921-22 were formed as a direct result of the scheme, and some of them dropped out when the Ministry's grant was discontinued. It is hoped, however, to secure their revival now that the grants have been restored.

The serious decline in horse breeding generally is reflected in the reduction in recent years in the number of stallions licensed under the Horse Breeding Act, 1918, which are given later in this report, and also by the decrease in the number of foals as shown in the Annual Returns furnished to the Ministry. In 1920 the number of horses under one year old given in the Annual Returns was 97,298, and this number has decreased each year until in 1924 the number was 54,700. It is noteworthy that the decrease since 1922 was more than double that between 1920 and 1922.

In view of these conditions it is not surprising to find that several societies have been unable to carry on without the Ministry's assistance and that others have been operating with considerable difficulty. The Ministry's grants may do something to arrest further decline in the breeding of heavy horses, and with the provision which has now been renewed for assisted nominations it is hoped that the smaller farmer, for whose assistance the scheme was primarily intended, will be encouraged to start afresh.

The following table shows the progress made under the Heavy Horse Scheme since its inauguration :—

Year	*No. of Stallions*	* *Total No. Mares served*	* *Averag No. of Mares served*	* *No. of assisted Nominations*	*Average Hiring Fee of Stallions*	*Average service Fee*
					£	£ s. d.
1914-15	72	6,365	68	1,503	231	2 8 6
1915-16	97	9,122	94	2,430	241	2 9 6
1916-17	108	9,995	92	2,181	244	2 11 0
1917-18	110	10,556	96	2,151	258	2 16 3
1918-19	122	12,281	100	2,165	285	2 15 8
1919-20	118	10,920	96	1,996	317	3 6 3
1920-21	105	9,133	87	1,839	345	3 13 1
1921-22	101	7,888	78	1,943	383	3 13 7
1924-25	87	6,098	70	†—	178	2 7 0

* Excluding the Cumberland and Westmorland Heavy Horse Society, which was formed in 1916 for the purpose of issuing only assisted nominations to selected stallions. The figures for this Society were as follows :—

Year	*No. of Assisted Nominations*	*Year*	*No. of Assisted Nominations*
1915-16 ...	385	1919-20 ...	264
1916-17 ...	394	1920-21 ...	254
1917-18 ...	328	1921-22 ...	255
1918-19 ...	321	1924-25 ...	121

The decline in the number of assisted nominations issued by this Society is due to the increased service fees which automatically increased the value of an assisted nomination and consequently reduced the number available from the Ministry's grant. In 1924-25 the Ministry's grant was reduced to one-half the amount given in previous years, hence the further decrease in the number of nominations issued.

† No grant was made by the Ministry for assisted nominations (except to the Cumberland Society) for the year 1924-25.

Horse Breeding Act, 1918.—As stated above in connection with the Heavy Horse Breeding Scheme there has been a continued decline in the number of stallions licensed each year since the Horse Breeding Act came into operation in 1920. The figures are as follows:—

Year (ending 31st Oct.)	*No. of Applications for Licences.*	*No. of Licences issued.*	*No. of Refusals.*
1920	4,153	3,749	404
1921	4,060	3,816	244
1922	3,644	3,479	165
1923	2,897	2,761	136
1924	2,285	2,210	75

Of the 2,210 stallions licensed in 1924, 2,019 were pedigree animals and the remaining 191 were horses that were not entered or accepted for entry in any recognised stud book.

The following tables show the number of stallions of each breed concerned that were licensed or rejected, and the number refused licences in respect of the various prescribed diseases or defects:—

NUMBER OF STALLIONS LICENSED OR REFUSED.

	Pedigree.		*Non-Pedigree.**	
Heavy.	*Licensed.*	*Refused.*	*Licensed.*	*Refused.*
Shire	1,151	47	44	1
Clydesdale	148	5	2	1
Suffolk	173	7	2	—
Percheron	53	1	1	—
Others	—	—	45	2
Light.				
Hackney	148	4	30	–
Thoroughbred	147	5	2	–
Arab	19	1	3	–
Hunter	4	–	4	–
Cleveland Bay	7	–	–	–
Yorkshire Coach	1	–	–	–
Welsh Roadster	1	–	1	–
American Trotter	–	–	8	–
Others	–	–	11	–
Ponies (including Welsh Cobs)	167	1	38	–
Totals	2,019	71	191	4

* Non-pedigree stallions are arranged as far as possible under types.

NUMBER OF STALLIONS REJECTED FOR THE PRESCRIBED DISEASES AND DEFECTS.

Roaring	20	Defective Genital Organs	3
Whistling	23	Stringhalt	2
Sidebone	12	Shivering	1
Cataract	8	General Unsuitability	1
Ringbone	1		—
Bone Spavin	4	Total	75

Fourteen appeals were made against refusals of licences, and in ten cases these were successful.

There is no doubt that the number of unsound stallions, which formerly travelled at very low fees and were a menace to the improvement of the horse breeding industry, have been practically eliminated from the road, and very few cases of infringement of the Act are now reported.

Sheep.—The financial assistance which the Ministry has given since 1919 towards the improvement of Welsh Mountain Sheep was continued during the year under review. Grants, up to a maximum of £10 for each ram provided, at the rate of 3s. 4d. per ewe served, were made to 13 societies in respect of 17 approved pedigree rams. The average hiring fee of the rams was £9 15s., and the average service fee 1s. 5d. The number of ewes served was 1,021, an average of 60 per ram.

Live Stock Officers report that the hill farmers are taking a keen and active interest in the operations of the sheep societies, which, it may be justly claimed, have been instrumental in directing the attention of flock owners to the importance of selecting suitable rams. Some of the hired rams and their progeny have been very successful in the show ring, and it is interesting to note that some of the sheep improvement societies conduct shows of their own for the exhibition of their lambs.

Milk Recording.—The Milk Recording movement has continued to make steady progress, as will be seen from the following table :—

	*Year.**	*Societies.*	*Members.*	*Herds.*	*Cows.*
1st April to 31st March	1914-15	16	264	306	7,331
	1915-16	20	350	398	9,811
	1916-17	22	441	495	12,950
	1917-18	25	503	555	14,404
1st October to 30th September	1917-18	27	639	708	19,793
	1918-19	38	1,191	1,332	37,880
	1919-20	46	2,075	2,312	61,323
	1920-21	52	3,328	3,664	97,903
	1921-22	55	3,949	4,362	117,023
	1922-23	55	4,365	4,767	127,151
	1923-24	52†	4,764	5,209	138,086

* Before 1st October, 1917, there was no uniform year for Societies.
† The decrease in the number of societies is due to amalgamation.

Opportunities have been taken during the year of effecting amalgamation in some cases where more than one society existed within a county. Experience has shown that a strong society for one county—one whose interests are less parochial—can usually be more efficiently and economically worked than a smaller society, and can more easily undertake the development of areas where the milk recording movement has not yet been established.

Average Yield of Herds Recorded.—The annual returns furnished by the 52 societies for the recording year ended 1st October, 1924, show that of the 138,086 cows and heifers recorded, 53 per cent. were cows which had been retained in the herds for the full year, and that the average yield of these 73,338 cows was approximately 7,030.1 lb. The appreciable advance which was made in this direction last year has thus practically been maintained. The following table compares the average annual yield of (1) all cows and heifers recorded, and (2) of the cows recorded for the full year for each year since the uniform milk recording year was fixed:—

Year: 1st October to 1st October.	No. of Societies.	Particulars of all Cows and Heifers recorded.			Particulars of Cows recorded for full Year.			
		No. of Cows and Heifers.	Total Yield.	Average Yield.	No. of Cows.	Percentage of Total Cows.	Total Yield.	Average Yield.
			gal.	gal.			gal.	gal.
1917-18	27	19,793	8,426,958	426	8,775	44	5,255,923	599
1918-19	38	37,880	16,204,941	450	17,989	47	10,543,516	579
1919-20	46	61,323	29,344,887	479	27,266	44	17,363,347	637
1920-21	52	97,903	48,512,380	495	48,248	49	30,892,620	640
1921-22	55	117,023	60,463,617	517	63 318	54	41,208,073	651
1922-23	55	127,151	67,904,224	534	68,349	54	46,956,565	687
1923-24	52	138,086	73,963,165	535	73,338	53	50,299,884	685

While the average annual yield of full-year cows for all societies has improved very gradually since the uniform milk recording year was fixed in 1917-18, the average in the case of some individual societies has shown very marked improvement. The following table illustrates the progress made in typical cases; and the cash value of such progress on the basis of one shilling per gallon of milk:—

Society	*No. of years during which records were taken*	*Average yield per cow in 1st year*	*Average yield per cow in last year*	*Increase in annual yield per cow*	*Number of cows in last year of period*	*Cash value of increase of last year over 1st year at 1/- per gallon*	
						Per cow	*On total No. of cows*
		gal.	gal.	gal.		£ s.	£ s.
A	6	595	705	110	632	5 10	3,476 0
B	4	582	722	140	935	7 0	6,545 0
C	4	522	690	168	681	8 8	5,930 8
D	5	567	761	194	1,780	9 14	17,266 0

With individual herds even more striking results have been obtained, and the following typical cases of herds of over 20 cows are of considerable interest:—

Herd	*No. of years during which records were taken*	*Average yield per cow in 1st year*	*Average yield per cow in last year*	*Increase in annual average yield per cow*	*Number of cows in last year of period*	*Cash value of increase of last year over 1st year at 1/- per gallon*	
						Per cow	*Per herd*
		gal.	gal.	gal.		£ s.	£ s.
A. (Non-pedigree Shorthorn)	5	589	793	204	21	10 4	214 4
B. (Non-pedigree Shorthorn)	7	524	821	297	30	14 17	445 10
C. (Pedigree Devon)	7	353	574	221	34	11 1	375 14
D. (Mixed Shorthorn and Friesian)	6	616	1,004	388	20	19 8	388 0
E. (Cross-bred, mainly Shorthorn)	4	364	711	347	46	17 7	798 2

These particulars bear testimony to the commercial value of the milk recording scheme, and as there is no reason to suppose that what has been achieved in many herds could not with the same care and attention be accomplished in most herds, the possibilities of the movement from the point of view of increased production of milk alone fully justify the efforts which have been made to promote this section of the Live Stock Scheme.

Competitions and Sales.—The institution of competitions for recorded herds, some of them carrying substantial awards, and the prominence now usually given to milk records in sale catalogues, are good testimony to the value attached to milk recording by those who have been interested in the movement long enough to have proved its advantages.

Although there has been no repetition of the boom in prices which occurred in 1921, the prices still obtained by non-pedigree recorded cattle compare very favourably with those given for pedigree animals. The following recent instances may be quoted in this connection.

At a sale in November, 1924, at Brenchley, Kent, 53 non-pedigree cows sold at an average of £46, the highest prices being 82, 76 and 60 guineas.

At Stony Stratford, 57 non-pedigree cows realised an average of £51, the highest prices being 100 guineas (twice) 88, 69, 65 and 60 guineas.

At a sale at Castleton, Monmouthshire, an average of 50 guineas was paid for 30 non-pedigree Shorthorns. Five realised over 70 guineas and one 185 guineas.

Register of Dairy Cattle.—The eighth volume of the Ministry's Annual Register of Dairy Cattle has been issued, covering the milk recording year ended 1st October, 1924. It is hoped that the Register will be of assistance to persons anxious to obtain dairy cattle with good milking records or the progeny of such animals, and of commercial value also to the owners of the cows and bulls entered in the Register. Twenty recognised breeds or types are represented in the volume, 62 per cent. being of the Shorthorn type, 17 per cent. Friesian, 3 per cent. Guernseys, and 5½ per cent. Crossbred. In order to make the publication a more useful work of reference the Ministry made in the last issue important changes in the conditions of entry and distribution, which may be summarised as follows:—

Cows.

1. In place of the former uniform standards of yield, *i e.*, 8,000 lb. for one year or 6,500 lb. average for two or more consecutive years, different standards have been fixed for the various breeds as follows:—

Breed or type.	*Yield (in lb.).*
Friesian	10,000
Ayrshire	9,000
Blue Albion	9,000
Lincold Red Shorthorn	9,000
Red Poll	9,000
Shorthorn	9,000
Crossbreds	9,000
All other breeds or types	8,000

2. The issue of a certificate of milk record is no longer a condition of entry.
3. Cows will be selected by the Ministry from the particulars furnished by members of Milk Recording Societies operating under the Ministry's Scheme, and if a greater number of cows give yields of or above the prescribed standards of their breeds than can be included in the Register, the highest yields of each breed only will be entered, regard being had to the percentage of animals eligible in each breed.
4. Cows in respect of which Certificates of Merit have been issued will be entered in the Register without further application from the owner, provided that (*a*) the certificate is for the period of three years ending with the Milk Recording Year in respect of which the Volume is issued, and (*b*) application for the certificate is received by 31st December following the close of that Milk Recording Year.

Bulls.

5. A bull must either be entered or accepted for entry in the Herd Book of its breed, and its dam and sire's dam must have given the standard yield prescribed for their breed or type in any particular year, or it must be entered or accepted for entry in the Herd Book of its breed and two or more of its daughters must have given the standard yield prescribed for their breed or type in any particular year.
6. No charge is made for entry of any cow or bull in the Register.
7. A copy of Volume 8 will be issued free to all members of Milk Recording Societies, and will be on sale to the public at 1s.

It is hoped that the revised arrangements, providing as they do for a much wider circulation of the Register, will create a greater interest and prove of much greater use.

Over 13,000 cows qualified for entry in Volume 8 of the Register on the above conditions, and of these 5,000 of the highest yielding cows were selected for inclusion in the printed volume. Practically all the cows entered have yielded 9,000 lb. or over in the year; 62 per cent. yielded between 10,000 and 12,000 lb., 23 per cent. between 12,000 and 14,000 lb. and 7 per cent. between 14,000 and 20,000 lb. Twenty-three cows gave 20,000 lb. or over.

Seventy-seven cows with certificates of merit are included in the volume, but the entry of bulls was very disappointing, only three being entered.

Milk Record Certificates.—There was a further considerable drop in the number of certificates issued, the number being 633 as compared with 2,065 for the preceding year. This decline is no doubt attributable to the fact that a certificate is no longer required as a condition of entry in the Ministry's Register of Dairy Cattle. In addition to the 633 certificates issued for a year or part year record, certificates of merit were issued in

respect of 83 cows. These certificates are issued in respect of cows which have calved not less than three times during a period of three consecutive years and which have, during that period, yielded not less than the amount of milk prescribed for their breeds. Of the 83 cows which were so certified during the year ended 1st October, 1924, 28 (including 19 Shorthorns, 4 Friesian, 2 Red Poll) yielded over 30,000 lb. during the three years. The highest yield, viz., 49,337 lb. was given by a non-pedigree Shorthorn cow. A second non-pedigree Shorthorn gave 38,508 lb. and a Red Poll cow gave 38,000¼ lb.

Calf and Bull Marking.—This useful auxiliary to the practice of milk recording is becoming more popular. All the societies have now adopted the scheme laid down by the Ministry, and during the year under review 14,248 calves and 114 bulls were marked. A prominent breed society now insists that their members who are " grading up " shall have their calves marked by their milk recording society.

Rationing.—The importance of proper rationing as a factor in the profitable production of meat and milk is gradually becoming more widely recognised, and the arrangements made by County Agricultural Organisers for providing assistance and advice to members of milk recording societies in this connection have been increasingly taken advantage of during the year.

Testing for Butter-fat.—While the practice continues in this country of selling milk by bulk and not by quality, the question of butter-fat content will naturally receive less attention than is desirable. Although compulsory testing for butter-fat is not a practicable proposition under the Ministry's Scheme, provision has been made for voluntary testing where desired by either the society or the member. Interest in this aspect of milk production is increasing, and the steps which have been taken in recent years to encourage the production of clean milk will no doubt assist in focussing the attention of farmers on the need for quality as well as of quantity in milk yields.

During the year ended 1st October, 1924, nearly 72,000 samples were taken and analysed, and over three-quarters of these samples were from the milk of individual cows.

Cost of Milk Recording.—There was a slight drop in the cost of recording during the year, both as regards the average cost per cow to the member and to the Society, which for the year ended 1st October, 1924, was 4s. 5d. and 6s. 4½d. respectively. While these costs cannot be said to be excessive, in view of the solid advantages now proved to be obtained by milk recording, it is desirable, from the point of view of inducing new members

to join societies, that the cost should be kept as low as possible. It is satisfactory, therefore, that the tendency is in the right direction, and with the more efficient working of societies, which has been an encouraging feature of the year under review, there is reason to hope that in due course it will be possible for any society to operate at a maximum average cost to the member of not more than five shillings per cow. In several cases, at present, where exceptional conditions exist, the cost to the member is much less than this.

Export of Live Stock to Colonies and Foreign Countries.— It is, of course, generally known among exporters of live stock and other products, such as hay, straw, hides, etc., from this country, that most foreign and colonial governments have made regulations governing the importation of live stock with the object of preventing the introduction of diseases. In many cases these regulations require that animals imported from Great Britain shall, *inter alia*, be accompanied by a certificate from the Ministry as to freedom from certain diseases of the districts from which the animals come. The Ministry has, for some years, undertaken the issue of certificates where required, upon application by the intending exporter giving the necessary particulars. In many cases the regulations also require a certificate of health of the animals concerned to be given by a recognised veterinary surgeon. Intending exporters can obtain information from the Ministry with regard to the requirements of any particular foreign or colonial regulations and, in this connection, it may perhaps be mentioned that, in order to avoid delay and expense, every care should be taken by exporters to make application as early as possible before the date of intended shipment, and to comply with the strict letter of the regulations, *e.g.*, in the wording of veterinary certificates.

Particulars of the number and declared value of animals exported to colonies and foreign countries are now published quarterly in this *Journal*. (See p. 568 of this issue.)

The following are the principal memoranda used in connection with the live stock operations of the Ministry, and single copies of them can be obtained free of charge on application to the Secretary, Ministry of Agriculture and Fisheries. 10, Whitehall Place, London, S.W.1:—

Leaflet 282. Scheme for Improvement of Live Stock.
Leaflet 146. The Value of Records of the Milk Yields of Cows.
No. 609/T.L. Bull Grant Regulations.
No. 392/T.L. Milk Recording Regulations.
No. 466/T.L. Boar Grant Regulations.
No. 89/T.L. Heavy Horse Regulations.

Statement giving Particulars of 52 Milk Recording Societies operating during the year ended 1st October, 1924.

(The Societies are arranged in order of total number of animals recorded.)

ociety.	*No. of Members.	*No. of Herds.	*Total No. of animals recorded.	*No. of Cows recorded for full year.	Average yield of cows recorded for full year.
Essex	230	254	8,940	4,853	7306.1
Somerset and North Dorset	242	283	8,460	4,868	6958.1
Hampshire	204	225	7,339	3,670	6959.1
East Sussex	200	241	7,067	3,862	6958.4
Berkshire	146	167	5,958	3,149	6959.7
Kent	182	211	5,639	2,981	7022.4
Hertford	169	189	5,607	3,008	7034.7
North-West Wilts ...	112	130	5,429	2,743	7109.7
Norfolk	180	202	4,948	2,738	7400.9
Dorset	82	106	4,865	3,168	6592.8
Surrey	174	184	4,728	2,446	6704.5
West Sussex	118	134	4,084	2,147	7054.2
Oxford...	103	112	3,738	1,936	7026.9
Warwick	135	142	3,539	1,638	7261.8
Lancashire	118	125	3,322	1,501	6695.3
Leicester	120	125	3,124	1,488	7211.5
Suffolk	135	147	3,121	1,901	7457.6
Salisbury	48	65	2,765	1,788	7664.1
Northants	98	111	2,415	1,197	6404.3
South Devon	107	112	2,358	973	6092.3
Yorkshire	133	138	2,261	1,133	7313.8
Shropshire	72	80	2,246	1,327	7223.7
Cambridge	84	92	2,228	1,234	7538.0
Cumberland and North Westmorland	131	135	2,050	973	5765.8
Stafford	79	85	2,030	1,084	7519.3
Derby	52	57	1,881	870	7524.8
Nottingham	54	58	1,868	773	7171.7
Bucks	66	70	1,845	999	7238.2
Cheshire	52	55	1,745	889	6903.3
Denbigh and Flint ...	84	86	1,664	851	6820.6
Bristol and Bath... ...	77	78	1,632	934	7412.2
Peak (Derby)	72	72	1,514	629	7226.0
Worcester	70	73	1,485	805	7375.3
East Devon	78	78	1,461	671	7053.6
Bedford	46	49	1,282	724	6941.6
Warminster and Mere ...	26	30	1,215	848	7286.3
Cornwall	59	60	981	541	6233.5
Kendal and S. Westmorland	49	50	971	398	5951.9
Lincoln	38	40	950	452	6956.2
Cotswold	43	43	947	610	7579.2
Tees Valley	28	36	920	444	7429.9
Anglesey and Carnarvon ...	84	85	896	526	5451.4
Herefordshire	35	35	842	427	7008.0
United Counties	59	60	819	425	6597.8
North Somerset	33	36	818	473	6977.8
Monmouth	34	36	764	344	6605.0
Campden Moreton ...	31	32	663	406	7002.6
Allendale	36	37	611	361	6833.9
Gloucester	29	30	599	338	7261.0
Melton Mowbray... ...	29	30	532	312	6740.1
Glamorgan	51	51	521	245	6776.2
Montgomery	23	23	399	237	6701.1
TOTALS	4,740*	5,185*	138,086*	73,338*	7030.1

* Goats are not included.

THE EFFECT OF LIGHT AND HEAVY DRESSINGS OF LIME ON GRASSLAND.

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IMPROVEMENT of grassland, both as regards yield and quality of herbage, is one of the great problems in agricultural practice. Increased yield and better quality represent greater stock-carrying capacity for a given area or, under favourable circumstances, more profit from the sale of hay, although a higher yield of hay does not necessarily entail increased financial gain. The judicious use of organic and artificial manures, and in certain cases the application of lime or chalk, do much towards bringing about the desired improvement, and much experimental work has been done in this connection. The action of lime, however, is apt to be so variable under different conditions that some recent results may prove of interest and value.

Experiments at Rothamsted.—In the course of long-continued experiments on grassland on heavy loam at Rothamsted the effect of similar and regular applications of lime has been found to vary according to the manurial treatment. A dressing of 2,000 lb. of lime per acre has been applied to one-half of each plot every four or five years since 1903, the other half remaining unlimed as a control. In the case of unmanured plots the lime has had very little constant effect upon the yield, but has altered the character of the herbage somewhat by increasing the proportion of grasses and leguminous plants and decreasing the miscellaneous plants or weeds. Furthermore, the proportion of such species as downy oat (*Avena pubescens*), quaking grass (*Briza media*) and meadow pea (*Lathyrus pratensis*) has increased, whereas bent grass (*Agrostis vulgaris*) sweet vernal (*Anthoxanthum odoratum*) and hawkbit (*Leontodon hispidus*) have been considerably decreased by liming. With complete mineral manures (including phosphate, potash, soda and magnesia), both with and without the addition of ammonium sulphate, liming has brought about a larger yield in every case, and has also radically altered the character and composition of the herbage, especially where nitrogen has been applied. Meadow foxtail (*Alopecurus pratensis*) shows a most striking response to lime with heavy manuring, the proportion increasing from 2 per cent. to 76 per cent. in some years, whereas Yorkshire fog (*Holcus lanatus*) and sweet vernal grass show a similar but less marked decrease in the presence of lime. Meadow pea, downy oat and smooth-stalked meadow grass

(*Poa pratensis*) are all usually favoured by liming, whereas bent grass, plantain (*Plantago lanceolata*), sorrel (*Rumex Acetosa*) and pignut (*Conopodium denudatum*) are generally reduced thereby.

Under these manurial conditions, therefore, liming on this particular soil has been beneficial both as regards yield and the quality of the resulting herbage, but under other conditions a different state of affairs occurs. Where nitrate of soda or mineral manures without potash have been applied liming has proved disadvantageous and has reduced the yield, the same effect being observed with organic manures, such as farmyard manure and fish guano. This rather unexpected result with the fairly heavy dressing of 2,000 lb. of lime per acre led to a further investigation to determine whether different dressings of lime would vary in their effect upon the crop, and whether lighter applications would improve, instead of reduce, the yield.

Three plots of known manurial treatment, hitherto unlimed, were selected in 1920, and the lime requirement of each was determined by two distinct methods. One of these (the Hutchinson Maclennan method) indicated the quantity for a heavy dressing, whereas the second (a colorimetric method, based on the hydrogen ion concentration of the soil) gave the figure for a light application. The plots were then subdivided, one portion remaining unlimed as a control, the other two receiving light and heavy dressings of lime respectively. Owing to the very different lime requirement of the plots, due to the varied manurial treatment, the actual amount of lime required for a light dressing in some cases (see C in table, p. 506) was considerably greater than that needed for a heavy dressing on the other two plots. For the sake of convenience, however, the term "light liming" is used throughout to denote the smaller dressing in each case, and "heavy liming" for the larger dressing.

The lime was applied in the winter of 1919-20 and again in 1923-24. Every year since, at the time of cutting, the yields from each portion have been kept separate and representative samples of the grass have been taken, dried carefully to preserve their colour, and separated into their constituent species to determine the progressive effect of liming upon the composition of the herbage. On these experimental plots it is usual to cut a second crop in autumn unless the growth of the aftermath is too poor to justify this procedure. No grazing is ever carried

out on the area, as the introduction of organic manure by sheep or cattle and the trampling of their feet would introduce factors which would render it difficult to determine the actual effect of the experimental manures and lime applied. In considering the following results, however, most importance must be attached to the figures of the first crop, as they represent the greatest value to the farmer, while the quality of the first crop hay is distinctly better than that of the aftermath.

The manuring and liming of the plots were as follows :—

Manuring. (*1905 & since*).	*Light liming.* lb per acre *applied 1920 & 1924.*	*Heavy liming.* lb. per acre *applied 1920 & 1924*
A. Dung every fourth year (14 tons per acre	570	3,150
B. Dung every fourth year (14 tons per acre), nitrate of soda and mineral manures in intervening years (e.g. dung 1905, artificials 1906, 1907, 1908) ...	570	2,772
C. Sulphate of ammonia, potash, magnesia and sulphate of soda every year	3,951	6,788

The lime requirements of the two plots receiving dung were very similar, enabling a close comparison to be made, and this rendered the difference in the action of the lime, as described below, all the more striking.

(A) **Dung Only.**—The lime was put on in the fourth year of the course, when the plot had received no dung for three seasons, and in the first year after application the yields with and without lime were very similar, the differences probably being within experimental error. With the application of dung in the next year, however, the liming appeared to work most disadvantageously, as the crop fell heavily with both dressings and continued at this low level till more lime was applied in 1924, when all the yields were again much alike. In 1922 the aftermath was also much lower on the limed plots, but in other years there was little difference. In Table I the yields for the four years' course after the first liming are bulked together, and that for the one available year after the second liming is shown separately :—

TABLE I.

	Total Yield 1920-23. cwt. per acre. *1st crop.*	*2nd crop.*	*Yield 1924.* cwt. per acre. *1st crop only.*
Unlimed	111.94	73.23	25.29
Light lime	92.65	61.93	24.21
Heavy lime	85.78	68.78	27.43

No very marked or constant change in the composition of the herbage was observed, except for a distinct reduction in the quantity of sweet vernal grass (as from 11.5 to 1.4 per cent.) with heavy liming, and some reduction of tall oat grass (*Arrhenatherum avenaceum*) (as from 8.5 to 1.9 per cent.) with light liming. It was noticeable that this latter reduction was much less marked with the heavy liming.

The reduced yield brought about by liming on areas receiving organic manure alone is also shown by another plot which is treated with dung and fish guano alternately every second year, with lime at the rate of 2,000 lb. per acre every four or five years. In this case the liming has been carried on for a longer period, since 1903, and its harmful effects were possibly increased thereby. Here again the application of lime in years when no organic manure was used (*i.e.*, 1920, 1924) temporarily levelled up the yields, but in the other three years a marked drop occurred, as shown in Table II.

TABLE II.

Applied.	1st crop (per acre). *Limed.* cwt.	*Unlimed.* cwt.	2nd crop (per acre). *Limed.* cwt.	*Unlimed.* cwt.
1919 Fish guano	35.07	44.98	14.87	15.93
1920 Lime	34.17	34.03	11.60	14.36
1921 Dung	34.28	37.55	—	—
1922 —	26.68	41.54*	18.46	23.08
1923 Fish guano	47.51	60.56	29.04	29.19
1924 Lime	38.10	49.19	—	—

The application of lime to land receiving dung or other organic manures alone, at least on heavy soils of this nature, seems therefore to be attended with considerable danger of crop reduction instead of improvement, and great care should be exercised before such a procedure is followed. The reason for the detrimental action is not clear, and it would be interesting to know whether similar results follow from the application of dung and lime on other types of soil, especially on those that are initially in greater need of liming than the Rothamsted loam.

(B) **Dung and Artificial Manure.**—The application of artificials, including nitrate of soda and minerals, to dunged grassland completely changed the effect of lime upon the area. Immediately after the first application the light dressing considerably improved the crop, this increase was maintained year after year, and after the second application of lime in 1924 the yield of the first crop was a ton per acre higher than that

* A shower of rain fell while this plot was being loaded on to the cart so that the weight was rather heavier than it ought to have been.

of the untreated plot and the grass was totally different in character, being dense and very dark green, in sharp contrast to the thinner stand of light green grass with no lime. With light liming, however, the second crop was always somewhat below that of the other two plots, though the difference was not usually great.

The heavy dressing, on the contrary, did not have the marked beneficial effect. The first crop was usually, but not always, slightly above that on the untreated plot, but its total increase due to heavy liming was only 10 cwt. over the whole period of five years, and the grass was light green and very similar to that on the untreated area. The yields were as follows:—

TABLE III.

	Total yields 1920-23. cwt. per acre.		*Yield 1924.* cwt. per acre.
	1st crop	*2nd crop.*	*1st crop only.*
Unlimed... ...	128.16	66.75	31.71
Light lime ...	151 67	53 46	51.08
Heavy lime ...	134.09	62 30	35.79

Rather unexpectedly the great improvement in the character of the herbage with light liming was not associated with any striking change in its composition, being due rather to a general all-round improvement in the habit and growth of most of the species present. Although heavy liming did not cause a corresponding improvement in growth, it had more effect upon a few individual species, causing a reduction in bent grass (*Agrostis vulgaris*) (as from 15 to 4.2 per cent.) and tall oat grass (*Arrhenatherum avenaceum*) (as from 6 to 0.4 per cent.), and some increase in downy oat (*Avena pubescens*) (as from 5.3 to 10.4 per cent.) and meadow foxtail (*Alopecurus pratensis*) (as from 16 to 20.9 per cent.).

In this case therefore, the rate of application of the lime was of vital importance, for whereas a moderate dressing at a reasonable cost brought about a considerable increase in yield and a decided improvement in the herbage, a heavy dressing at a much greater cost failed to produce any appreciable rise in yield and had much less beneficial effect upon the grass. The result suggests that on land that is well manured with dung supplemented with artificials, a light dressing of lime may prove a remunerative investment, though the usual heavier application would be of little or no use, resulting actually in financial loss.

(C) **Artificial Manure without Phosphate.**—This combination of manures is exceptional, as it is very rarely used in practical farming, but it was selected in order to ascertain what happens when grassland receiving lime is deficient in phosphate. With

this type of manuring lime had more effect upon the distribution of growth throughout the year than upon the total yield. Both light and heavy dressings of lime appreciably raised the yield of the first crops, but this was set off by a corresponding decrease in the second crops, the total yields being very similar on the untreated and limed plots over the whole period of experiment. In the first years after the application of lime the light dressing appeared to be more beneficial, but this superiority over the heavy dressing was not maintained and the total first crops in both cases were much the same over the four year course.

TABLE IV.

	Total yield 1920-23. cwt. per acre. *1st crop.*	*Total yield 1920-23.* cwt. per acre. *2nd crop.*	*Yield 1924.* cwt. per acre. *1st crop only.*
Unlimed... ...	94.13	86.73	28.02
Light lime ...	120.85	51.03	32.46
Heavy lime ...	124.56	59.19	29.52

The heavier first crops with liming followed by decreased second crops may indicate that under these manurial conditions growth is considerably hastened by the application of lime, resulting in a heavier bulk of grass at the time of the first cutting, but leaving the herbage less able to produce a heavy aftermath. Without lime less growth is made at first, but the grass is able to carry on more vigorously after the first cut, yielding a much heavier aftermath which more than compensates in bulk for the lower first crop, though from the point of view of the farmer the heavier first crop with lime is probably of more value than the correspondingly heavier aftermath in its absence.

Although, on balance, liming had so little effect on the total yield, it brought about some improvement in the quality of the herbage, in that both light and heavy dressings reduced the percentage of the rather undesirable bent grass (*Agrostis vulgaris*) (as from 72 to 26 per cent.) and increased the amounts of the more useful foxtail (*Alopecurus pratensis*) (as from 14.6 to 22.6 per cent.) and tall oat grass (*Arrhenatherum avenaceum*) (as from 0.3 to 10 per cent.). One curious and rather unexpected development was that sorrel (*Rumex Acetosa*) was in this case increased by liming (as from 2.2 to 9.7 per cent.). Sorrel is usually considered to indicate some degree of soil acidity and to be decreased by the application of lime which reduces this acidity. It seems doubtful, however, whether sorrel should be regarded as a true indicator in this way, as other factors than acidity appear to affect its prevalence. Possibly, in this case, the absence of phosphate from an otherwise complete fertiliser may have had something to do with

its increase in the presence of lime. More information is necessary, however, before this point can be settled.

This particular experiment illustrates a case in which similar results were obtained with both light and heavy dressings of lime, the extra money spent on the heavier dressing being therefore wasted. Also, where first crop hay is the desideratum, it indicates how liming may aid towards an increased crop, though this may be at the expense of the aftermath.

Profit or Loss due to Liming.—As a general rule the mere attainment of increased yields by means of liming is of little use to a farmer unless the value of the increase more than compensates for the cost of the lime and its application. Certainly under some circumstances, in cases where the herbage is originally of a very poor type, the improvement in quality may more than balance a failure to obtain increase in crop or even a slight actual loss in crop, but these instances are likely to be the exception rather than the rule. For the sake of demonstration a costings table has been drawn up for the experiments described above. The cost of lime has been reckoned as 30s. per ton, and the cost of spreading has not been included. The value of the first crop has been taken at 90s. per ton, and of the second crop at 75s. per ton, both being average market prices for hay of the quality obtained. In Table V the increases and decreases in crops and the monetary values of the same are reckoned in comparison with unlimed areas in each case:—

TABLE V.—ESTIMATED PROFIT OR LOSS PER ACRE DUE TO LIMING.
(1ST AND 2ND CROP.)

Liming.	Increase (+) or decrease (—)		Value of increase (+) or decrease (—).			Cost of Lime.	Estimated Net profit (+) or loss (—) over 4 years.	Average profit (+) or loss (—) per ann.
	1st crop. cwt.	*2nd crop.* cwt.	*1st crop.* £ s. d.	*2nd crop.* £ s. d.	*Total.* £ s. d.	£ s. d.	£ s. d.	£ s. d.
	A.	*Dung only.*						
Light	—19.29	—11.30	—4 6 10	—2 2 5	—6 9 3	7 8	—6 16 11	—1 14 3
Heavy	—26.16	—4.45	—5 17 8	—16 8	—6 14 4	2 2 2	—8 16 6	—2 4 1½
	B.	*Dung and Artificials.*						
Light	+23.51	—13.29	+5 5 10	—2 9 10	+2 16 0	7 8	+2 8 4	+12 1
Heavy	+5.93	—4.45	+1 6 8	—16 8	+10 0	1 17 2	—1 7 2	— 9½
	C.	*Artificials without*	*Phosphate.*					
Light	+26.72	—35.70	+6 0 3	—6 13 10	—13 7	2 12 11	—3 6 6	—16 7½
Heavy	+30.43	—27.54	+6 16 11	—5 3 3	+1 13 8	4 10 11	—2 17 8	—14 4

A consideration of the above table shows that in only one case was there a net profit per acre when both first and second crops were considered, a light dressing of lime with dung and artificial manures showing a profit of 12s. 1d. per acre. In every other instance a loss was experienced, from 14s. 4d. per acre with artificials and lime to as much as £2 4s. 1½d. per acre when a heavy dressing of lime was used in conjuction with dung. This net loss is in most cases due to the fact that the second crops are less heavy on the limed than on the unlimed areas, and to the heavy cost of liming per acre, as the loss on these two items more than counterbalances the gain on the first crop due to liming. As a matter of fact, the second crop would not be cut in ordinary farm practice, and it is difficult to estimate the value of the aftermath when grazed off instead of being allowed to grow on for cutting. The difference in treatment might bring about an entire alteration in the value of the second crop. This being the case, it may be of interest to see the value of liming with regard to the first crop only, as this would usually provide the criterion whereby a farmer would judge whether the treatment had justified itself or not:—

TABLE VI.—ESTIMATED PROFIT OR LOSS PER ACRE DUE TO LIMING. (1ST CROP ONLY.)

Liming.	*Value of increase (+) or decrease (—) of 1st crop.* £ s. d.	*Cost of Lime.* £ s. d.	*Net profit (+) or loss (—) over 4 years.* £ s. d.	*Average profit (+) or loss (—) per annum.* £ s. d.
	A. Dung only.			
Light	—4 6 10	7 8	—4 14 6	—1 3 7½
Heavy	—5 17 8	2 2 2	—7 19 10	—1 19 11½
	B. Dung and Artificials.			
Light	+5 5 10	7 8	+4 18 2	+1 4 6½
Heavy	+1 6 8	1 17 2	—10 6	—2 7½
	C. Artificials without Phosphate.			
Light	+6 0 3	2 12 11	+3 7 4	+16 10
Heavy	+6 16 11	4 10 11	+2 6 0	+11 6

From this point of view liming was a more profitable proposition except where dung alone was used. With this the loss per annum was still very considerable, just £2 per acre with heavy liming, and more than half as much with the light dressing. With dung and artificials, however, the profit per acre with the light dressing was twice as much as when the second crop was considered, and the loss with the heavy dressing was reduced to 2s. 7½d. In both these cases the order of events was the same whether one or both crops were taken into account, though the actual amount of the profit or loss was altered. With artificials only, on the contrary, the loss

incurred with the two crops became a corresponding profit where the first crop only was concerned, owing to the alteration in the season of greatest growth caused by the lime. It is thus shown by these tables that in estimating the value or otherwise of various dressings of lime, other factors than that of actual increase in yield of the hay crop have to be taken into account, including the cost of the lime itself and the importance of the aftermath in the economics of the farm.

Summary.—The results obtained may be briefly summarised as follows:—

(1) With dung only the use of lime in heavy or light dressings caused a reduction in yield both of first and second crops, and no very marked change in the composition of the herbage was observed except with sweet vernal grass and tall oat grass.

(2) With dung and artificials a light dressing of lime brought about a substantial increase in the first crop, which far more than counterbalanced a certain decrease in the aftermath. The character of the herbage was greatly improved, but more by the generally enhanced growth of most species of plants, than by the special encouragement of a few species only at the expense of the others. Heavy liming did not cause the marked increase in the first crop nor so much reduction in the second. Furthermore, though little improvement in growth appeared, bent grass and tall oat grass were considerably reduced, and downy oat grass and meadow foxtail increased in proportion in the herbage.

(3) With artificials without phosphate the total yields were not much affected, but growth was earlier with both light and heavy liming, resulting in an increased first crop and decreased second crop. Liming brought about some improvement in the herbage by reducing bent grass and increasing foxtail and tall oat grass.

(4) The profit or loss due to liming has been calculated, showing a heavy loss where lime was used in conjunction with dung alone, but a moderate profit when a light dressing of lime was given with dung and artificial manures.

* * * * * *

A SIMPLE GUIDE TO THE PURCHASE OF FEEDING STUFFS.

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THE selective purchase of concentrated feeding stuffs is, for the farmer, a constantly recurring problem. Various methods of procedure are found in practice. A few farmers still adhere to a traditional formula and confine their purchases to such well-known favourites as linseed cake and cotton cake. Others, having become convinced of the special value of one particular cake or meal, stick to it regardless of price variation: for example, yellow meal may be the *sine qua non* in one case or in one district, and bean meal in another.

There are also a number of farmers who adopt the principle that all purchases of concentrated foods should be avoided. In those cases where the home-grown foods include such a variety of crops as beans, peas and linseed, as well as cereals, this attitude has much to commend it, but where home-grown concentrates comprise only cereals, adequate production rations are then unattainable without recourse to outside supplies.

Although these methods of providing the required concentrates for stock purposes are fairly common, the majority of farmers deal with the question from a more flexible angle. In some cases it is found advisable to supplement a varying quantity and quality of home-grown foods with purchased concentrates; while in others it may be necessary to purchase all the production part of the rations.

There also arise such questions as which of the home-grown foods should be fed and which sold, and which concentrates make the most suitable purchases. These points of view recognise two simple facts: (1) that the choice of feeding stuffs depends on circumstances as well as prices, and (2) that there is a great variety of concentrated foods to choose from.

The question arises therefore, " On what plan, if any, is the selection made from the very extensive range of products on the market? " It must be admitted at once that very often the purchaser simply depends on his own shrewdness and experience, though necessarily this must greatly limit his choice, as few have had experience of more than a few of the possible feeding stuffs which are available.

Sometimes advice is given by merchants and dealers, and where these are the representatives of reliable firms, the advice is usually sound and readily taken. The salesman may strongly recommend a certain food on the grounds that, at the time, it is relatively cheap. In this way also the farmer may be induced to try something new, while compound foods are frequently sold after this fashion.

Alternatively, the farmer may proceed in the most business-like manner by studying price lists and writing for quotations from various firms. Each week prices of feeding stuffs are published in the agricultural press. Since the introduction of uniform weights, these lists are of considerable use, but there still remains scope for great improvements in the method of their presentation. In the weekly market returns issued by the Ministry, comparative prices are set out in a systematic manner. A comparison of the unit prices which are given for each food enables the reader to see at a glance which foods are relatively expensive, and which are cheap, and a summary of this information is usually published in the agricultural press

In practice, however, a difficulty arises in making use of these figures—published market prices, f.o.r. London or other port, or ex store, do little more than indicate the trend of prices; they cannot be translated into actual costs at the nearest station or on the farm, and they may in some instances differ considerably from the prices of the same foods or alternative foods from a local source.

It must therefore be very disconcerting to find after the most careful study of the *published* figures, that these differ from *local* prices, and that the variation is not a uniform one up or down, but actually alters the order of relative values. This frequently happens in practice, and brings the farmer back to the original position—that he must exercise his own shrewdness or set to work with paper and pencil to make fresh calculations of unit prices. It is an unfortunate position, most discouraging to those who are only too anxious to proceed in the most businesslike manner.

This short article has therefore been written in order to present a simple table which can be permanently used under all circumstances as a reliable guide to the economical purchase of feeding stuffs.

The method employed in arriving at unit prices in the table is that used in the Monthly Notes on Feeding Stuffs (see Note at the foot of page 559 of this *Journal*). That this method is

not strictly accurate is admitted, but on the other hand it is the most reliable, simple method available. Long experience of its use confirms the soundness of the results obtained, and the writers have no hesitation in recommending the figures.

First it will be noticed that all the most commonly used foods have been arranged into a series of Groups. The foods in each group are similar in composition and one can be substituted for another in production rations. This arrangement is extremely useful, not only in connection with the purchase of foods, but also as a guide to the making up of production rations for dairy cows.

Use of the Table.—The method of using the table to indicate which are the cheapest foods is very simple: two examples only need be given:—

(1) A farmer wishes to replenish his supply of decorticated cotton cake. He knows that any of the foods in Group 2 will answer the same purpose, and he therefore invites quotations from various firms for all the foods mentioned in this group.

He receives offers as follows, and using the table reads off the unit prices opposite each food below the prices quoted, thus:—

Food.	*Price quoted per ton.*	*Unit Prices from Table.*	*Unit Price.*
Cotton Seed Meal ...	£11 5 0	2/2 plus ¾	2/2¾
Decorticated Cotton Cake	£13 0 0	2/11	2/11
Soya Bean Cake ...	£10 15 0	2/1 „ 2½	2/3½
Decorticated Ground Nut Cake	£11 15 0	2/2 „ 2½	2/4½
Undecorticated Ground Nut Cake	£10 0 0	2/10	2/10
Sesame Cake	£11 0 0	2/2	2/2

It is immediately seen that the difference in value between cotton seed meal and sesame cake is negligible, and that either or both of these might be used, also that the foods in order of cheapness are—sesame cake, cotton seed meal, soya bean cake, decorticated ground nut cake, undecorticated ground nut cake and decorticated cotton cake.

(2) A farmer finds his supply of oats will shortly be exhausted. This food he knows can be replaced by one or more of those given in Groups V and VI.

His quotations are as follows:—

Food.	*Price quoted per ton.* £	s.	d.	*Unit Price from Table.* s.	d.	d.	*Unit Price.* s.	d.
Oats...	10	0	0	3	1	—	3	1
Wheat	12	0	0	3	1	—	3	1
Maize Germ Meal ...	9	10	0	1	11	plus 1½	2	0½
Maize	10	10	0	2	3	„ 1½	2	4½
Rice Meal	8	5	0	2	0	„ ¾	2	0¾
Barley Meal ...	10	15	0	2	7	„ 2½	2	9½

Clearly a purchase of either oats or wheat at the prices quoted would be very uneconomical. Maize germ meal is the cheapest direct substitute, or a suitable combination of maize germ meal and rice meal might be used.

The facilities which the Table provides for comparing relative values of foods may be turned to another use, namely, to indicate whether home-grown foods should be sold or fed. This may be illustrated from the above figures for foods from Groups V and VI. Oats, which can be sold at £10 per ton, are relatively expensive for feeding. Owing, however, to their special value for horses and calves, sufficient for these purposes might be retained and the remainder sold. If the price of oats should rise and other prices remained the same, the incentive to sell would be correspondingly increased.

Barley meal at £10 15s. per ton is reasonably near in value to other foods, but when barley meal recently cost up to £14 per ton or 3s. 9d. per unit, it was clearly very easy to find cheaper substitutes. Even pig feeders in such circumstances were tempted to omit barley from their rations or to reduce greatly the quantity fed.

Lastly, wheat at £12 per ton is relatively expensive, and *would usually be sold off the farm even if this necessitated the purchase of other food stuffs.*

Limitations of the Table.—*The special value of the Table lies in the fact that it can be used continuously as a guide to the relative feeding values of foods whether purchased or home grown.* Posted up in an office it should always prove of service. It is well, however, to emphasise the fact that a system of this kind can act as a guide only for the following two main reasons:—

(1) The figures are necessarily based on the *average* compositions of the feeding stuffs mentioned. Most of the foods, however, do not vary greatly from the average.

(2) A knowledge of the specific properties of feeding stuffs is essential for their proper use.

Unit Prices of Feeding Stuffs at different Costs per Ton.

Feeding Stuffs.	Starch Equivalent.	Unit Price at the following Costs per Ton.														
		£5	£6	£7	£8	£9	£10	£11	£12	£13	£14	£15	5s.	10s.	15s.	20s.
		s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	d.	d.	d.	d.
Group II. *Very Rich in Protein*—																
Cotton Seed Meal	74	7	10	1 1	1 4	1 7	1 11	2 2	2 5	2 8	3 0	3 3	¾	1½	2½	3¼
Decorticated Cotton Cake ...	70	7	11	1 2	1 6	1 9	2 0	2 4	2 7	2 11	3 2	3 5	¾	1½	2½	3¼
Soya Bean Cake	69	7	11	1 2	1 6	1 9	2 1	2 5	2 8	3 0	3 3	3 6	¾	1½	2½	3¼
Decorticated Ground Nut Cake	73	6	10	1 1	1 4	1 8	1 11	2 2	2 5	2 9	3 0	3 3	¾	1½	2½	3¼
Undecort. Ground Nut Cake ...	57	1 1	1 5	1 9	2 1	2 6	2 10	3 2	3 6	3 11	4 3	4 7	1	2	3	4¼
Sesame Cake	73	7	10	1 1	1 4	1 8	1 11	2 2	2 6	2 9	3 0	3 3	¾	1½	2½	3½
Group III. *Rich in Protein*—																
Cotton Cake Bombay ...	40	1 8	2 2	2 8	3 2	3 8	4 2	4 8	5 2	5 8	6 2	6 8	1½	3	4½	6
Cotton Cake Egyptian ...	42	1 6	2 0	2 6	3 0	3 5	3 11	4 5	4 10	5 4	5 10	6 3	1½	3	4½	6
Linseed Cake	74	9	1 0	1 4	1 7	1 10	2 1	2 5	2 8	2 11	3 2	3 6	¾	1½	2½	3¼
Beans	67	1 0	1 4	1 7	1 11	2 2	2 6	2 9	3 1	3 5	3 8	4 0	¾	1½	2½	3½
Grain	71	1 0	1 4	1 7	1 10	2 2	2 5	2 9	3 0	3 3	3 7	3 10	¾	1½	2½	3¼
Peas	69	1 0	1 3	1 7	1 11	2 2	2 5	2 9	3 0	3 4	3 7	3 11	¾	1½	2½	3½
Maize Gluten Feed	75	1 0	1 3	1 6	1 9	2 0	2 4	2 7	2 10	3 1	3 4	3 8	¾	1½	2½	3¼
Group IV. "*Balanced*" *Foods*—																
Malt Culms...	41	1 7	2 1	2 6	3 0	3 6	4 0	4 6	5 0	5 6	6 0	6 5	1½	3	4½	6
Brewers' Grains Dry	48	1 7	2 0	2 5	2 10	3 3	3 8	4 1	4 6	4 11	5 4	5 9	1	2½	3½	5
Palm Kernel Cake (6% Oil) ...	75	1 0	1 4	1 7	1 10	2 1	2 4	2 7	2 11	3 2	3 5	3 8	¾	1½	2½	3¼
Palm Kernel Cake Extracted ...	71	1 1	1 5	1 8	1 11	2 3	2 6	2 9	3 1	3 4	3 8	3 11	¾	1½	2½	3¼
Coconut Cake	79	1 0	1 2	1 5	1 8	1 11	2 2	2 5	2 8	2 11	3 2	3 5	¾	1½	2½	3
Wheat Offals— Fine Middlings	72	1 1	1 4	1 8	1 11	2 3	2 6	2 9	3 0	3 4	3 7	3 11	¾	1½	2½	3¼
Coarse Middlings ...	64	1 3	1 6	1 10	2 2	2 5	2 9	3 1	3 5	3 8	4 0	4 4	1	2	3	3¾
Pollards	60	1 4	1 8	2 0	2 4	2 8	3 0	3 4	3 8	4 0	4 4	4 8	1	2	3	4
Bran	45	1 7	2 1	2 6	3 0	3 5	3 10	4 3	4 9	5 2	5 7	6 1	1¼	2½	4	5¼
Linseed (whole)	120	7	9	11	1 1	1 3	1 5	1 7	1 9	1 11	2 1	2 3	½	1	1½	2
Group V. *Starchy Foods*—																
Oats	60	1 5	1 9	2 1	2 5	2 9	3 1	3 5	3 9	4 1	4 5	4 9	1	2	3	4
Wheat	71	1 2	1 5	1 9	2 0	2 3	2 7	2 10	3 1	3 5	3 8	4 0	¾	1½	2½	3¼
Rye	71	1 2	1 5	1 9	2 0	2 3	2 7	2 10	3 1	3 5	3 8	4 0	¾	1½	2½	3¼
Maize Germ Meal	85	11	1 2	1 5	1 8	1 11	2 2	2 5	2 7	2 10	3 1	3 4	¾	1½	2¼	2¾
Group VI. *Very Starchy Foods*—																
Maize	81	1 0	1 3	1 6	1 9	2 0	2 3	2 6	2 9	3 0	3 3	3 6	¾	1½	2¼	3
Rice Meal	72	1 2	1 5	1 9	2 0	2 3	2 6	2 10	3 1	3 4	3 8	3 11	¾	1½	2½	3¼
Barley	71	1 2	1 6	1 9	2 0	2 4	2 7	2 11	3 2	3 5	3 9	4 0	¾	1½	2½	3¼

ERADICATION OF SHEEP SCAB.

The Minister has had under consideration representations which have been made to the Department to the effect that the existing regulations relating to sheep scab are prejudicial to the sheep trade and inconsistent with the actual position with regard to sheep scab in certain parts of Great Britain. The representations referred to have been directed particularly against the regulations made by many Local Authorities requiring the double dipping of sheep moved into their districts from other counties, and it has been urged that the powers of Local Authorities to make such regulations should be withdrawn and that the necessary measures for dealing with sheep scab should be imposed by the Ministry alone.

The Minister is anxious that in dealing with this disease the minimum of restrictions should be placed upon the sheep trade. At the same time he is faced with a demand from agriculturists for a policy aimed at the eradication of scab. It has, therefore, been necessary in considering this matter to arrive at a plan to achieve eradication but involving the minimum of restriction on the sheep trade.

It will be useful in this connection to review the main lines of the already existing policy. These are as follows:—

(a) *Infected Premises.*—The Sheep Scab Order of 1920 requires that where sheep scab is declared to exist, all affected sheep on the premises shall be kept separate and dipped as often as may be necessary until cured, but at least twice with an interval of not less than 7 and not more than 14 days between the two dippings. Other sheep on the same premises and sheep moved elsewhere which on enquiry are ascertained to have been exposed to infection, are detained by notice until they have been double dipped.

(b) *Infected Areas.*—The Sheep (Double Dipping) Order of 1920 is applied by the Ministry to areas where sheep scab is prevalent or is suspected to exist unreported, the Local Authority being consulted with a view to the application of the Order to a suitable area. The effect of this Order is briefly:—

(i) to prohibit movement of sheep, other than sheep for immediate slaughter, out of any such area unless double dipped within the previous twenty-eight days, and/or

(ii) to require the double dipping with an interval of not less than seven and not more than fourteen days between the dippings, of all sheep in the area during a specified period which is fixed after consultation with the Local Authority.

(c) *Local Regulations*.—Article 12 of the Sheep Scab Order of 1920, as amended by the Sheep Scab (Amendment) Order of 1923, empowers Local Authorities to make regulations requiring the dipping of sheep within, or moved into, their districts, and many Local Authorities have exercised these powers.

(d) The Sheep Scab Order of 1923 requires sheep owners to take such steps as are reasonably practicable to secure that their sheep are free from scab. It provides that occupiers of farms or holdings upon which sheep are kept and owners of sheep kept on common land shall be liable, in case of failure to take such steps, to the penalties prescribed by the Diseases of Animals Acts.

It will be observed from headings (a) and (b) that sheep scab is at the present time dealt with on the premises and in the areas where it occurs. In view, however, of the difficulties of detecting scab in its earliest stages and the widespread distribution of the disease, these measures (a) and (b) alone, would not be sufficient to check the spread of the disease by the movements of sheep from one part of the country to another if the protective regulations of the Local Authorities were withdrawn. If, therefore, these local protective regulations are to be dispensed with, effective measures must be devised to take their place.

New Proposals.—This is the purpose of new proposals which have been drawn up by the Ministry and embodied in a draft Order which, together with an explanatory memorandum, has been forwarded to representative bodies concerned in order that the latter may have an opportunity of expressing their views on the proposals before they are brought into operation. A copy of the memorandum is given below.

The basis of these proposals is the general compulsory double dipping of all sheep in the country, accompanied by movement restrictions, limited to a comparatively short period of each year (15th July to 31st August), the remainder of the year being free from restrictions or from the requirement of dipping on movement. The Minister is advised that double dipping thoroughly performed with an interval of not less than 10 and not more than 14 days between the two dippings, must constitute the essential feature of any eradication plan, and that the most hopeful prospects of success will lie in effecting a general thorough double dipping of all sheep at one and the

same time throughout the country under conditions which will ensure that the beneficial effect of such dipping in one district will not be neutralised by subsequent contact of dipped sheep with sheep which have not been similarly treated. In the new plan, however, it has been considered necessary to provide for the exemption of whole counties which have been free from scab for the preceding two years, subject to proper conditions which will safeguard such counties against the risks of the re-introduction of the disease.

The provisions of the draft Order are not intended to supersede the present action with respect to Infected Places and Areas under the Sheep Scab Order of 1920 and the Sheep (Double Dipping) Order of 1920, but the withdrawal of the powers of Local Authorities to make their own regulations and the revocation of the Sheep Scab Order of 1923 will constitute a necessary part of the new scheme.

The Minister feels that it should rest with those concerned in the sheep industry to decide whether they will accept the measures considered to be necessary for the eradication of sheep scab or whether they will be content with merely controlling the spread of the disease.

It cannot be made too clear, however, that the most carefully devised measures will fail to achieve their object unless all concerned are prepared loyally to abide by the decision ultimately arrived at, and will co-operate actively to ensure that the regulations imposed are efficiently carried out. This will certainly mean a greater expenditure of time and money in the future in connection with the provision of proper dipping appliances, the careful mixing of the dipping bath in accordance with directions, the thorough dipping of each sheep, the cleansing of the bath and dipping places, and the separation of dipped from undipped sheep, etc. The observance of these matters should ensure the eradication of scab within a period of three or four years, but failure in any of these respects will jeopardise the success of the scheme and either prolong the period of its operation indefinitely or necessitate the abandonment of eradication in favour of control.

MEMORANDUM EXPLAINING PROPOSED SHEEP (GENERAL DOUBLE DIPPING) ORDER.

The draft Order proposes to put into operation a plan for the eradication of scab, involving dipping requirements and movement restrictions limited to a comparatively short period of the year (15th July—31st August), the remainder of the year being free from restriction or from the requirement of dipping on movement.

Special measures will in addition as at present be applied by the Ministry to the worst infected areas, and the Sheep Scab Order of 1920 with certain amendments will continue to apply to the sheep concerned in individual outbreaks of scab.

The draft Order contains the following main requirements:—

(1) *Compulsory General Double Dipping.*—All sheep throughout Great Britain will be required to be double dipped during the period from the *15th July to 31st August* except in any county declared by the Ministry to be exempt on the ground that it has been free from scab for at least the two preceding years. It will be within the absolute discretion of the Minister to consider on its merits whether a county should be declared "exempt" in which an isolated outbreak of scab had occurred originating from outside sources. Special provisions described below will apply to exempted counties.

The prescribed double dipping will be a dipping twice with an interval of not less than ten and not more than fourteen days between the two dippings by a thorough immersion in an approved sheep dip. After sheep have been double dipped they must be kept separate from undipped sheep during the remainder of the dipping period.

(2) *Notice to be given of intended dippings.*—To enable the Local Authority to supervise the dippings as far as practicable, the owner or person in charge of any sheep will be required to give notice to the Local Authority of the intended dippings of his sheep. The first notice must state the total number of ewes, rams, lambs, and other sheep on the premises on the first day of the prescribed dipping period, *i.e.*, on the 15th July.

In view of the importance of making adequate provision for the supervision of dippings, Local Authorities will be invited to enlist the assistance of farmers on a voluntary basis, and, with this object, to consult established agricultural bodies in their districts as to the individuals who should be appointed as temporary inspectors of the Local Authority for this particular purpose.

(3) *Returns and Declarations of Dipping.*—The owner or person in charge of any sheep must send a return on a prescribed form to the Local Authority in respect of each lot of sheep dipped during the dipping period. Forms for this purpose must be obtained from the Local Authority. After the dipping period has expired, a declaration must be furnished to the Local Authority by the 10th September, on a prescribed form showing that all sheep on the premises have been duly double dipped.

In the case of any sheep which the owner has failed to dip in accordance with the Order, the Local Authority will be required, without prejudice to any legal proceedings, to serve a Notice on the owner prohibiting the movement of the sheep until they have been double dipped under supervision.

(4) *Restrictions on inter-county movements of sheep during the dipping period, 15th July to 31st August.*—In order to prevent evasion of dipping by movement of sheep from one district to another, and the mixing of dipped with undipped sheep, the following restrictions on movement from one county to another are imposed by the draft Order.

Sheep may only be moved from one county to another if accompanied by—

(*a*) a certificate of the Inspector of the Local Authority of the district from which they are moved showing that the sheep have

been double dipped under the supervision of an Inspector during the dipping period, or within twenty-eight days immediately preceding the movement, or

(b) a licence from an Inspector of the Local Authority of the district from which they are moved authorising movement to a slaughterhouse. In the latter case the sheep must be marked on both sides with the letter "M."

A county for the purpose of restrictions on movements includes all the boroughs therein.

(5) *Restrictions on exposure of sheep at markets during the dipping period, 15th July to 31st August.*—All sheep exposed for sale in any market, fairground or saleyard during the dipping period (15th July to 31st August), must have been double dipped during that period or within the twenty-eight days immediately preceding the date of exposure for sale, and must be accompanied by a written declaration showing particulars of the dippings.

All markets, fairs or sales of sheep help during the dipping period must be authorised by the Local Authority. This will be done on the condition either—

(a) that an Inspector of the Local Authority will attend the market or sale to receive declarations and certificates showing that the sheep brought to the market or sale have been duly double dipped, and also to issue certificates to purchasers giving them the dates of the dippings, to be utilised where required for the purpose of the further movement of the sheep, or

(b) that the Market Authority or auctioneer will, if authorised by the Local Authority, receive such declarations and certificates showing that the sheep brought to the market or sale have been double dipped, and issue certificates to purchasers as above.

The above requirement as to dipping of sheep exposed at a market will not apply to a market, fair or sale authorised by the Local Authority to be held exclusively for fat sheep intended for immediate slaughter. All sheep exposed at such a market or sale must be moved under licence direct to a slaughterhouse.

(6) *Provisions applicable to exempted counties.*—The following provisions will apply throughout the year to any county which has been declared by the Minister to be exempt from the general compulsory double dipping required by the Order, the object being to provide a continuous protection from the risk of the reintroduction of scab from non-exempted counties:—

(a) The arrival of sheep moved into such county from any county not exempted must be notified to the Local Authority and the sheep must be double dipped as soon as practicable after arrival at a farm in the exempted county.

(b) Where sheep from outside an exempted county are exposed at a market or sale in an exempted county, *all* the sheep at such market or sale must, on removal to a place of destination (other than a slaughterhouse) in an exempted county, be double dipped on arrival at the place of destination. The Local Authority will have power to authorise special markets in an exempted county at which none but sheep from within an exempted county will be exposed. In these cases dipping of the sheep exposed at the market will not be required on removal to a place of destination in an exempted county.

(c) The above provisions relating to exempted counties will not apply to sheep accompanied by a certificate of the Local Authority of the district from which they come, stating that they were double dipped under supervision during the double dipping period (15th July to 31st August); that the second of the two dippings took place within twenty-eight days before movement; and that since the second dipping the sheep were kept separate from undipped sheep.

(7) *The following Orders will be revoked*:—

(a) The Sheep Scab Order of 1923, which places upon sheep owners the onus of taking all reasonable steps to keep their sheep free from scab. This Order has not been found practicable to enforce effectively.

(b) The provisions of Article 12 of the Sheep Scab Order of 1920, as amended by the Sheep Scab (Amendment) Order of 1923, empowering Local Authorities to make regulations requiring the dipping of sheep moved into their districts, and requiring the general dipping of sheep in their districts. It is considered that the eradication plan described above will obviate the necessity for the existence of the present local regulations.

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VISIT OF THE AMERICAN YOUNG FARMERS' CATTLE JUDGING TEAM TO EUROPE, 1925.

THE championship for judging dairy cattle open to the Young Farmers' Clubs of the United States of America was won last autumn at Milwaukee by a team from the Franklin County Dairy Calf Club, Iowa. The team consisted of three boys: Harlan Leonard, aged 19; Raymond Monahan, aged 18; and Lester Olsen, aged 18, and had been trained by Mr. V. B. Hamilton, the County Agriculturist of Franklin. This team had successfully competed with 19 other teams, the local champions of their respective counties in the State of Iowa. Similar eliminating contests had taken place in 24 States, so that the Franklin team won the championship against approximately 50,000 competitors. The prize included a trip to Europe, the State to which the winning team belonged giving 4,000 dollars and the various Dairy Associations adding a further 750 dollars towards the expenses of the trip. It appears to be an established custom for the winning State to subscribe the amount named. It is of interest to note that Franklin County teams won the State championship in fat stock judging, and the National Championship for bread-baking open to girls in connection with Young Farmers' Clubs. There are 368,640

FIG. 1.—Judging Shorthorns.

FIG. 2.—Judging Jerseys.

acres in the county and 2,300 farmers. The land is valued at 200 dollars per acre. The team left Iowa on 24th May and visited Washington en route, travelling thence to Montreal and Liverpool and reaching London on 8th June. The boys were accompanied by Mr. and Mrs. V. B. Hamilton and Mr. Earl Weaver, Professor of Dairy Husbandry at the Iowa State College of Agriculture, Ames, Iowa.

The party was entertained at luncheon at the Farmers' Club, Whitehall Court, on 9th June, Miss Pratt and Mr. Robinson, of the Ministry, being present. After lunch, Westminster Abbey and the Government Buildings in Whitehall were visited, and later a programme for a tour on the Continent and to the Channel Islands was arranged for the visitors. The tour included Holland, Denmark, Switzerland, France and Germany, Jersey and Guernsey. The party travelled by air from London to Amsterdam.

Returning to London on the morning of 2nd July, Lord Astor's Cliveden Estate at Taplow was visited during the afternoon. Miss Pratt and Mr. Robinson accompanied the party to Cookham, where Mr. Hubert Smith, Lord Astor's agent, met them and conducted them round the farm, where an opportunity was afforded the visitors to see and handle some Dairy Shorthorns. The stud farm was also visited, the thoroughbred mares with foals at foot being seen. Mr. and Mrs. Smith entertained the party to tea.

On Friday afternoon, 3rd July, Mr. Robinson accompanied the visitors to Derby, an interesting programme having been arranged by Mr. J. R. Bond, County Agricultural Organiser. The party stayed at the Royal Hotel, Derby, from Friday until the following Monday. At 7.30 p.m. on Friday a cattle judging contest took place at Mr. Henry Adams' farm at Shipley, where some good Dairy Shorthorns were seen. Mr. and Mrs. Adams entertained a large party to supper after the contest.

On Saturday morning a visit was paid to Mr. Gilbert's herds of Lincoln Reds and Friesians at Chellaston, after which Mr. Gilbert took the party back to Derby for lunch. In the afternoon another contest was carried out with the Kilburn team at Mr. C. C. Mort's farm at Holbrooke, near Derby.

Sunday was spent in the fields looking at Mr. Gilbert's and Mr. Mort's cattle.

The party left Derby at 3 o'clock on Monday for Reaseheath, Nantwich, where rooms had been booked through the kindness

of Mr. Mercer, of the Cheshire School of Agriculture, so as to afford an opportunity of visiting the Royal Show at Chester.

On Tuesday and Wednesday, 7th and 8th July, the party visited the Royal Show, and on Wednesday evening Professor Weaver paid a private visit to Wigtonshire, while the rest of the American party proceeded to Edinburgh until the morning of 15th July. Professor J. A. S. Watson, of Edinburgh University, arranged an interesting programme for this part of the tour, which included a visit to the Highland and Agricultural Society's Show at Glasgow on 14th July. The party arrived back in London on the evening of 15th July. On 17th July the Fourth International Dairy Cattle Judging Contest for Young Farmers' Clubs took place in the Reading district, between the American team and the following team representing England: Dorothy Dean, aged 17, Northease Jersey Calf Club; Ronald Knight, aged 18, of the same Club; Leslie White, aged 17, Hemyock Calf Club. The American team won by 28 points and carried off the *Daily Mail* gold challenge cup. An account of this contest was given in the August issue of this *Journal*, p. 475. Photographs relating to it accompany the present note.

Shopping and sight-seeing occupied the American visitors until the afternoon of Tuesday, 21st July, when Mr. Robinson took them to Windsor. Mr. Conacher, the manager of the Royal farms, spent a couple of hours taking the party round the farm buildings and showing the dairy and the various herds.

On the afternoon of 22nd July, Lord Balniel, M.P., escorted the Young Farmers, with Miss Pratt and Mr. Robinson, round the House of Commons and was also good enough to obtain tickets to enable them to hear a debate.

Mr. Raymond Monahan went to Ireland from 18th-22nd July, visiting Belfast, Dublin and Cork, and was given letters of introduction by the Ministry of Agriculture in Dublin to a few farms and Farm Institutes.

The American party left Waterloo on 23rd July for Southampton to embark for New York on the U.S. liner "George Washington."

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COUNCIL OF AGRICULTURE FOR ENGLAND.

A special meeting of the Council was held at the Middlesex Guildhall, Westminster, on Thursday, 6th August, 1925, to consider the Report of the Committee which had been set up to make recommendations to the Council for suggestions to the Minister of Agriculture on the question of the Agricultural Policy for the Country. Mr. James Donaldson (Oxfordshire) was in the Chair, and the Right Hon. Edward Wood, M.P., Minister of Agriculture, was present during the greater part of the proceedings.

Lord Clinton, Chairman of the Committee, presented the Report. He referred to the representative character of the Committee and to the fact that the Report had been signed by ten of the eleven members of the Committee, with reservations by two of them, viz., Mr. C. S. Orwin and Sir Douglas Newton. It was understood that the members, although drawn from landowners, tenants and workers (Lord Clinton, Sir Douglas Newton, Lord Selborne, landowners; Mr. Donaldson, Mr. George Rea, Captain Morris, tenants; Mr. George Edwards, Mr. George Hewitt, Mr. Tom Lovell, workers; and Mr. C. S. Orwin, agricultural economist), did not, in sitting on the Committee, represent any organisations connected with Agriculture. Lord Clinton said he would, with permission, take the Report in two parts, the first relating to the Subsidy for Production and Employment, the second referring to a Permanent Policy.

With regard to the first part, he said that the Government had asked assistance in the matter and had laid it down that the object in view was to secure that the industry be conducted in such a manner as will secure the maximum employment of labour at reasonable rates of wages together with the full use of the land for the production of food at the lowest possible prices consistent with a fair return to those engaged in the industry. The only method to achieve this was to increase the arable area, and that could not be done under present conditions except by State aid. Subsidies in themselves were objectionable and uneconomic. They led men to rely upon the State rather than to their own individual efforts, and were only admissible when the imperative need of the nation demanded them.

Arable farming was difficult to maintain, because of unrestricted foreign competition and the consequent slump in home

cereal prices to the level of world prices. Then there were the vagaries of the British climate and the heavy taxation of agricultural land. These and other causes meant the laying down of land to grass, lower production and less employment of labour—all evils which directly affected the State itself. He did not envy those in power who had the responsibility of taking a decision in circumstances so difficult. The Committee's recommendation was, however, clear. It had gone further than any other body in suggesting the actual form of a suitable subsidy. It recommended a subsidy of £2 per acre on the fallow land or fallow crop in every farming rotation, not more than one quarter of the arable land of a holding to count for subsidy in any one year.

The main objects of such a subsidy were to maintain the land in good condition full of fertility capable of being turned to the nation's use at short notice, and, secondly, to maintain upon the land the full complement of men and horses, of implements, machinery, and husbandry. A subsidy for cereal crops alone, in so far as it encourages the growth of those crops to an unnecessary degree might defeat the very object aimed at, because, by over-production of those crops, the fertility of the land would be reduced, and the attainment of a high state of efficiency at the moment it was wanted would be prevented. Other objects and advantages were laid down in paragraphs 5, 6 and 7 of the Report. Lord Clinton added that the fallow, being the foundation of our farming systems, its treatment necessarily governed the whole rotation.

Mr. W. R. Smith, in opposing the subsidy, stated that whenever agriculturists got down to consider this question it was always the suggestion of a subsidy that emerged from their deliberations, and, although they did not ask for it, it was rather interesting to know that side by side with the declaration that they wished to be left alone they were always asking the State to do something for them and the position in that respect was a little contradictory. It was easy even with the best of intentions to do more harm than good even by a policy of this description. The 1920 Act, in opening up possibilities and hopes to agriculturists, did more harm to the industry than if it had never been passed at all; and agriculturists should hesitate before they attempted to evolve a policy which was likely to have only a very short existence. He did not think that there was a single person in the hall who could state with any confidence that the subsidy would naturally and necessarily bring a

single acre more land under the plough than existed before. It was a speculation at most. He asked whether potatoes were to be covered by the definition of fallow crops. If so, money would be given away for nothing. Not one single degree would be added to the efficiency of the soil by the subsidy in regard to that class of farm and £2 per acre will be a direct gift to those farmers, without the country getting anything in return. We had the very best farmers in this country that there are in the world and land was in many respects cultivated to the highest point.

In the remainder of the Report, a series of suggestions was being put forward and practically all were going to cost money. Agriculture was now receiving grants amounting to 4½ millions a year. The Minister had said recently in the House of Commons that "the average farmer will not realise that he is about as capable of buying his supplies on level terms from the wholesalers or merchants as the average housewife would be of making a good bargain for the household tea supply if she went to Mincing Lane." That was rather a damaging statement, and supporters of agriculture and farmers would have to remove the grounds for it before they came to the country and asked for subsidies in the way they were now doing in this report.

Sir Walter Berry said that he had recently journeyed to Scotland by one road and back by another and had motored from Canterbury into Gloucestershire by one road and back by another; he had been by train to Lincoln and motored from Lincoln to Norwich and back to London by train. With the exception of a very small portion of the country he had seen, agriculture was in a deplorable condition and hopeless unless something was done. Weeds in corn land were due mainly to the want of fallowing, and farmers could not afford to fallow their land at present because of the cost, and so were muddling on. During the war land had got into bad condition, in which it still was, farmers being unable to overtake the weeds. He was strongly in favour of the proposed subsidy and hoped that the Council would not be side-tracked into any discussions which were beside the mark with a view to killing it.

Mr. W. W. West (Isle of Ely) said he did not agree with giving the subsidy for fallowing, it should rather be given on the actual crops required and produced. He was Chairman of the Isle of Ely Agricultural Committee, and the Director of Agriculture had plenty to do without going all over the farms and seeing how much land was fallowed and how much crop

was grown on it. In his district, farmers could not afford to fallow the land unless growing potatoes were fallowing.

Mr. Bruford (Somerset) asked whether the Government had made up its mind to give a subsidy to agriculture as it had done to mining. He thought a subsidy on arable land was useless: his own land would not be cultivated better or produce more on account of it, and there were many other farms in the same position. The proper method of going to work was to stabilise the price of corn at 60s. at least.

Captain Morris (Herts) said that in his opinion the subsidy, for the great bulk of the land in the country, required no defence. It was quite easy to put up destructive criticism, but the Council's Committee had produced a constructive proposal which would certainly be for the benefit of the nation with regard to the poor and the medium class soils. They (the destructive critics) were speaking for a very small proportion of agriculture in the country. He knew particularly with regard to one county, that something like 80 per cent. of its smallholdings this year were under white straw crops. That was not in the interests of the smallholder or in the interests of the nation. He wished to suggest that this subsidy was an entirely different proposition from the ordinary subsidy, because in the main it was paid for something being done. He had a lively recollection of other subsidies which gave something for nothing, but here there was in this fallow or fallow crop subsidy an absolute certainty of successful cereal growth afterwards and the easiest possible form of inspection of agricultural land. Was it suggested that to get a fourth of the land in this country put in a fertile condition was of no benefit to the nation, or that that land could be put into a better condition of fertility without more employment of labour? He appealed to the Council to lift the question out of the ruck of party politics and consider it on its merits. He was absolutely convinced that the subsidy would do much to improve the arable acreage; also that the nation could not continue to go on with regard to agriculture as it was doing. It was surely in the interest of the nation to stop the decline in the arable area. Did the nation require more population in its rural areas, or did it not care? He asked objectors what they had got to put in place of the unanimous report of the representatives of all three parties connected with the land?

Mr. George Edwards, in the course of his speech, said he had had experience of agriculture for nearly 75 years. In the last 30 years, the numbers of labourers had dropped from

900,000 to 600,000 and there were 3,000,000 acres less under the plough. Further, the quality of arable land to-day was not more than 70 per cent. of what it was 30 or 40 years ago. Mr. Smith had said that if the subsidy were given there was no guarantee that one more acre of land would be brought under cultivation. He would analyse that. The suggestion in the Report was that the granting of a subsidy was to be placed in the hands of County Agricultural Committees, and they would not give it unless they were satisfied that the land was being properly cultivated. Some land therefore would not be growing weeds or thistles or docks. On the other hand, the best would be got out of the land, which could not be well cultivated unless more labour were employed. He was getting alarmed at the depopulation of the villages, and at the physique of the people that were being reared in the villages.

The Report desired to see a return to the proper rotation of crops, because land would not stand a continuity of white crops. That was the objection to giving a subsidy on corn or wheat. The Committee did not want to encourage the farmer for the sake of getting the money to grow corn continually. It objected to Mr. Orwin's proposals in respect of a graded subsidy on agricultural land after considering them. That would cut out the smallholder, because it so happened that the man with the least land had to pay the highest rent. The Committee's proposal would benefit the smallholder. As to wages, it could be left to the Wages Board to see to it that labour was protected, and that labourers would get the highest and best wages that the industry could pay.

Mr. George Nicholls said that he had been unable to sign the Report because he could not agree that the subsidy was the best proposal that could be made for agriculture. He gave his reasons for that view, and said that he would be prepared to put up other suggestions for a better solution of the problem.

Mr. George Dallas considered that it should be made clear that the Report was not one by the three parties in agriculture, it was made by individuals only. He suggested that agriculture got enough subsidy as it was: it also had a Department of State to look after its interests.

Alderman Davis (*Durham*) said he was a firm believer in the policy of the bare fallow: a crop looked brighter and better after it. He thought landlords might be asked to forego the rent whilst the land was in bare fallow. He did not, however, agree with the subsidy.

Mr. John Evens (*Lincs*) said that in his view there were two clear-cut issues—what the farmer wants and what the nation wants. A few years before the war he had 700 acres of arable land and 300 acres of pasture. Within the last two or three years he had seeded down 200 acres and had to-day about 500 acres of each. If present conditions continued with regard to costs and prices, he would seed a little more down, and go on in that way because that was the only method in which he could economically manage his farm. The best land would take care of itself, but most of the country could be classed only as three or four quarters an acre land. If that land were to remain under cereal cultivation, some way must be found which would help it to be profitably done. The proposals before the Council were likely to do that more surely than anything else that had been put forward.

Mr. F. T. K. Cross (*Berks*) supported the adoption of the Report though he disliked the principle of subsidies. If the nation wanted more arable land then the policy outlined was the best to adopt.

Mr. George Hewitt, a member of the Committee, said that the criticisms had come from the people who did not live as near to the land as those who had had the honour of drafting the Report. Advocating a subsidy on fallow land would seem very strange to people who did not live directly from the land. The nation would get back in four years a cleaner country than it had to-day, and if one quarter of the land could be cleaned by this means certainly the land would be a greater asset to the nation. He failed to see why the man who grew corn should not have as high a standard of living as the man in the town who made shoes for him. It was a national problem and agriculture should be assisted.

Mr. Haman Porter said he could not vote for the Report because he saw vast dangers behind it, of which nationalisation of land was one.

Mr. Quinney (*Birmingham*) said he would vote with the Committee on both sections of the Report. Farmers had never asked for a subsidy, but when the Government of the day said they wanted certain things done, certain alterations on the land made in the national interest, farmers wanted to obey, but as reasonable men they had to be safeguarded against loss. For that reason he was quite prepared to swallow the word which is hateful to the ears of the Englishman, viz., subsidy.

Mr. R. L. Walker (*Yorks, W.R.*) said that the good land would have to be considered, and that there was much that would require no subsidy at all; moreover many farmers would not care to receive it. As to smallholders in the West Riding, it would be difficult to justify a subsidy except in the case of a very few.

Mr. Ashby said that agriculture to-day was as well able to stand upon its own feet as any other productive industry in this country, and better than most. There were farmers, and in some districts the majority of farmers, who were to-day better off as regards capital, profits, and income than they were in 1913, even if allowance were made for the reduction in the value of money. The speculation of the subsidy was one in which every scrap of evidence that exists was against the speculation. Under the Agriculture Act of 1920, thirteen or fourteen million pounds had been paid in January, 1922. In that very year, the arable acreage of this country went down. In proportion to the total agricultural land, the arable area was as great to-day as it was in 1913, the only difference being that the total area has shrunk very considerably.

Mr. W. B. Taylor (*Norfolk*) expressed thanks to the Committee for the Report so far as Norfolk was concerned; it was not so much whether the individual farmer was making money or whether he was not, because good business men would make money in almost any industry, bad as the times were even to-day. Two-thirds of the land of Norfolk was only second-class land, and a good deal only third-class land. The returns from that land showed a constant increase in the acreage laid down to grass which was not its best use, and, slowly but surely, the country districts were being depopulated in consequence, which meant loss to the nation. He criticised the Report in that it gave no guarantee to workers that they would get a proportion of the subsidy. He considered also that smallholders should have their rates remitted, and some of their rents, where the latter were unfair.

Mr. Matthews (*Hereford*) asked whether all members of the Council had been requested to send in suggestions as to Agricultural Policy to the Committee, and if so, why the critics had not sent in their proposals. The Chairman replied to the first part of the question in the affirmative. Mr. Matthews went on to commend the Report, particularly for the smallholders.

Mr. Rea (*Northumberland*) asked the critics of the Report if they were prepared to follow their objection to its logical conclusion. If this Report were defeated and nothing done, then it is almost directly saying to the farmers, " Do as you like, lay your land down to grass as far as you please." Were they prepared to face the national danger which will confront the country in the event of another war? Were they prepared also to say to the rural workers, " We don't care anything for your interests, we are not going to help the farmers to take you in employment. If the farmers cannot do that off their own bat you will have to look after yourselves." He paid a tribute to the work of Mr. George Edwards and his labour colleagues on the Committee. He asked whether Mr. Smith and Mr. Dallas were prepared to go to the country and say to the workers whom they represent, " We can do nothing for you, and we don't agree that anything should be done to help agriculture, so of course you run the risk of losing your employment." The logical conclusion of that position was that the Wages Board must be scrapped and the whole industry allowed to go to pieces.

Mr. R. C. Grey (*Hunts*) pointed out that with the subsidy would go inspection, enquiry and demands for more wages. He was, however, prepared to support some such proposal if only to grade the bad farmer. He preferred Mr. Orwin's reservation to the Report itself. If his reservation were adopted, inspection would extend to the whole arable area.

Sir Douglas Newton (*Cambs*) said that the Report had at any rate served one good purpose in the interchange of ideas which had taken place; that could only be for the good of all and for the industry as a whole. The problem, so far as he had visualised it was how best to maintain the food supplies of the nation, the rates of pay of the workers engaged in the industry, and ensure a reasonable return to farmers. Now, so far as the food supplies were concerned, that was a national question and not for the Council to determine; but with regard to the wages of the worker. They must be finally determined on economic lines and according to the success and prosperity of the industry. That was immediately a farmer's point, and he had hoped to hear more upon it.

Mr. Fawkes (*Yorks, W.R.*) enquired what the administrative cost of the proposal was likely to be. The Chairman said the Committee was assured that it would not be great.

The discussion of the first part of the Report was then closed, and *Lord Clinton,* in replying to the debate, said that he thought the real point of the subsidy proposal had been missed in the discussion. Over and over again speakers had spoken of the subsidy as a means to enable the farmer "to carry on." It was nothing of the kind. In this Report—and he had taken the greatest pains in his opening speech to say it—there was a great distinction drawn between the industrial and the national side. From the industrial side, nothing had been said about a subsidy—farmers could still hold their own; they could make a living. Under the arable system, to which the labour critics should have paid more attention, there was no way except by it that a satisfactory number of men could be kept employed on the land. There was no other way in agriculture under which you could give them a decent rate of wage.

The Chairman then put the motion in favour of the adoption of the Report; it was carried by 49 votes to 14.

Lord Clinton then proposed the adoption of the second part of the Report under which the following are the headings of the paragraphs:—Permanent Policy; Application of Agricultural Education and Research to Agriculture; Small Holdings, Cottage Holdings, and Rural Housing; Agricultural Credit; Better Marketing and Transport of Agricultural Produce; Steadying of Agricultural Prices; Burdens on Land; Land Drainage; and Liming. He dealt briefly with each heading.

Mr. Gibbons (Gloucester) expressed himself more in favour of assisting smallholders than in giving a subsidy to farmers; the question of loans to smallholders had, however, after the experience under the Land Settlement Act provisions, to be very carefully dealt with in the counties. He also laid stress on the need for better drainage.

Mr. J. Lousley (Berks) said that loans to smallholders in his county had gone very well indeed.

Mr. Gardner (Worcs) said that rural schools should give a thorough grounding in the elements of education and should specialize afterwards. Housing, also, was a most important matter, the crux of success with small and large holdings. He also dealt with the other items in Part II.

Lord Bledisloe, Parliamentary Secretary to the Ministry, said in reply to a question by *Mr. Thomas (Hants)* as to the Drainage Bill, that the Bill would be introduced into Parliament next year at latest, and possibly in the autumn session of this year.

The Cabinet yesterday had decided to continue the grants for unemployment work on drainage for the coming winter. A considerable sum of money was also about to be devoted to drainage work as carried out by Drainage Boards and Commissioners of Sewers for the period of the next five years. Mr. Gardner had supported liming; at the Ministry it was considered that there was enormous scope for land improvement by liming, and, as Lord Clinton had said, it was not much good to lime seriously undrained or waterlogged land.

Mr. Clement Smith (*Suffolk*) said that in East Suffolk there was a large acreage of light land that required liming. He had just recently had an opportunity of paying an extended visit to Holland, and one thing he had noticed was the improved methods of marketing agricultural produce.

Mr. Dallas congratulated the Committee on the excellent second part of the Report. He did not agree about elementary education, however. All education of an elementary character should be without any occupational basis whatever. All the children who go to the elementary schools were not the children of agricultural workers or the children of farmers, and were not necessarily going into agriculture.

Lady Mabel Smith spoke on the subjects of elementary education, and the position of women in regard to agriculture. Women were persuading the men to leave the country districts because they feel their children have not the facilities there for elementary education, for extended education, and for finding work afterwards, as have the children of the urban and town worker; so that anything the Council could do by way of obtaining improved educational facilities would be of great value.

Mr. Hamilton (*Lancs*) spoke in favour of the Report, and *Lord Selborne* dealt with the criticism that had been made as to the recommendations on education. There was undoubtedly at present an anti-rural bias in many of our country elementary schools. He did not think that it was conscious or intentional; it had come from the fact that some of the teachers—most devoted and splendid people—had no special appreciation or experience of the country. What was meant by a rural bias, which might first begin with the teacher and then be communicated to the child, was that he should be taught the glories of country life, and more nature study. He should not grow up to look down upon agriculture as a despised and degraded industry, but should be taught to understand that it is one of

the most noble industries and professions, and that the agricultural labourer, so far from being an unskilled man, was a very skilled man indeed.

Mr. H. Thomas (Hants) suggested that unemployed labour should be used for the chalking of land.

Mr. W. R. Smith, in supporting the second part of the Report, criticised certain details in regard to a smallholdings policy, housing and drainage.

Mr. George Nicholls also said he wished to support this part of the Report. He replied to Mr. Smith's criticisms on smallholdings policy.

Mr. A. R. White (Wilts) said he wished to support the extension of smallholdings. In regard to water supply, he hoped that the Government would include that kind of scheme in their .and drainage work.

Lord Bledisloe replied that he was not yet in a position to give an undertaking that water supply schemes would be included. He said that the Ministry was profoundly grateful to this Council for submitting this report on the question of agricultural policy. It obviously had involved a great amount of earnest work, and whether the Ministry was able to submit to the Government these particular proposals or not, the Council might be assured they would have the deepest consideration. In one respect, the proposed Government policy had been definitely announced, viz., in regard to smallholdings, and he was glad to note that there had been expressions of keenness, if not enthusiasm, in relation to this topic, from all parts of the Council. The Government realised, in connection with smallholdings, that whatever may be the case with regard to larger holdings, co-operation was absolutely essential if economic success was to be achieved.

Lord Clinton briefly replied to the discussion, and thanked the Council for the response it had given to the Report.

The Chairman put the second part of the Report, which was carried without any dissentient vote.

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THE OTTER.

PROFESSOR J. ARTHUR THOMSON, M.A., LL.D.,
University of Aberdeen.

THE otter (*Lutra vulgaris* or *Lutra lutra*) belongs to the same family (*Mustelidæ*) as the badgers and stoats, and is ranked in the bear-like section of the order of Carnivores. That is to say, its affinities are rather with bears than with cats or with dogs. It is one of the oldest mammals in Britain (its bones have been found in the Norwich Crag of the Later Pliocene period), and it has established itself in all parts of the country. It is commoner than is supposed, but it readily escapes observation owing to its elusive ways and to the fact that it works a good deal under cover of darkness. It frequents streams where there is good fishing, and lakes as well; in some parts of the country it hides in caves by the sea shore and swims out to adjacent islands. It must be regarded as a very successful animal for, in spite of much persecution, it enjoys a wide distribution both in the Old World and the New, especially in the more northern parts. The "holt" or "hover" is in most cases a well hidden hole by the side of the stream, and the exit is usually under water so that the tenant can slip quietly away. Although the otter is so much at home in the water, it likes to rest and sleep in a dry place, and the "nest" is often made comfortable with reeds and grasses bitten into short pieces. In some cases the same otter seems to have several "holts."

Some Characteristic Features.—The otter has a long strong body, 2 to 2½ ft. in length, and a very muscular steering tail which extends for about 16-20 inches more. The head is broad and rather low, with large eyes, long, thick, sensitive whisker-hairs or vibrissæ, and short ear-trumpets with openings that can be closed in diving. Very striking on the cleaned skull is the deep locking of the lower jaw into its socket, for the otter takes a firm grip of things. There is fine moulding about the skull, and the ridges for the insertion of the muscles of the jaw and neck bespeak great strength. There are sharp prominences on the back teeth that help the otter to keep hold of a slippery fish. The short strong limbs are both webbed and clawed, equally well suited for swimming and burrowing. There is the usual pair of odoriferous glands under the broad

FIG. 1.—The Otter

root of the tail. A not uncommon weight for a dog otter is 20-25 lb., and 15-18 lb. for the female, but much heavier individuals have been recorded. Roughly speaking we may calculate a pound in weight for every inch in the length of the head and trunk. The otter is deep brown above, grey to yellowish grey below; but very dark-coloured varieties sometimes occur. As is usual, there are long outer hairs and a lighter under-fur. It is interesting to notice how greatly the shape of the animal changes when the outer hairs get thoroughly wetted, but whether wet or dry the otter is an animal of fine lines, indicative of its athletic development. Its whole appearance suggests power, yet without the heaviness of the badger or the bear.

The Otter's Bill of Fare.—One of the reasons why the otter holds its own that it can thrive on so many different kinds of animals. In the main, it depends on eels, trout, salmon, pike, flatfish and the like, but it also condescends to eat snakes, fresh-water mussels and worms. It does not despise the edible mussels on the sea-shore, breaking the shells with its teeth, and it will also take limpets from the rocks. The frogs from the marsh are a delicacy, and so are young rabbits and wild duck. The otter has certainly a very wide range of appetite, and there is no denying that it may take chickens and ducklings, and other young birds, though the damage done in this way is quite trivial. There is no disputing that it levies toll on trout and salmon, often biting them in the throat and getting a draught of blood from the heart. But as Millais points out in his *Mammals of Great Britain*, "taking everything into consideration, otters do no harm to fish, even on big salmon rivers, and he is a churlish fisherman indeed who grudges this graceful creature his share." The fact is that otters devour many other fishes besides trout and salmon, that their check on the multiplication of eels and pike is all to the good, and that they are also useful in getting rid of the old male trout, which are very fond of the spawn and fry of their kind. In all these cases, one must take a broad view.

Habits.—The otter has very keen senses of sight, hearing, touch and smell, and it is almost impossible to catch one napping. It has a fine brain and is extraordinarily resourceful as well as alert. It is equally at home on land and in water, by night and by day, in a dry burrow or on a shelf under a

waterfall; it can enter the pool without a splash and swim near the surface with scarce a ripple; it can dive in the sea in a spiral full fathoms five, and lie under the bank on a stream for hours, with its nostrils raised into a space between water and earth. It knows its own footsteps in the thicket and will not retrace them; it almost never goes back to a kill, for that way danger lies; it will carry a water-trap on its shoulders and wrench it off on the roots of an alder-tree; it will dive at the flash of the gun and elude the bullet; it is an outlaw of unsurpassed alertness and resource.

Its severest trial is a hard and prolonged frost, when the waters of the lake are sealed. The otter may hunt for pike beneath the ice, or for eels and tench buried deep in the mud—but this is a terribly dangerous expedient. There are wild-fowl to be sought after, but they also have to leave the frozen waters. It is then that the otter in desperation will begin to inquire by night into the state of the farmer's poultry-yard.

Mr. J. C. Tregarthen's *Life Story of the Otter* is a very fine piece of work, based on a lifetime of observation of this very unapproachable animal. One of the features that he emphasises is the otter's roving disposition. "The homeless hunter," he calls it, "the Bedouin of the wild." "It has been known to travel fifteen miles in a night, and not infrequently the holts where it lies up during the day are ten or twelve miles apart." The otter passes from tarn to stream, from river to shore; it swims far out to sea and reaches isolated rocks; it wanders along the cliffs and explores the caves; it crosses the heath-covered hills and even the mountain passes, sheltering among the bracken or in the heart of a cairn; it neither stores nor hibernates, but is always on the move—a gipsy among carnivores. It is plain that the restlessness of habit will increase the otter's chances of life.

The agility of the otter in climbing and jumping, as well as in swimming and diving, is past all praise. In swimming near the surface it uses both fore and hind feet. In deep swimming it uses only the fore feet. The hind feet are stretched out behind and the tail serves as a kind of rudder. It can remain a long time below the surface, even under the ice, but in some reported cases of prolonged immersion it has probably been to the surface unnoticed. The otter's cry is a long whistle, and the creature hisses like a cat when attacked.

Family Affairs.—Otters seem to be monogamous and have strong maternal instincts. There may be savage fights

between two rival dog-otters who desire the same mate. The female is rather smaller than the male. There is usually but one litter in the year, and gestation occupies sixty-three days. Before she gives birth, the female selects and prepares a suitable and inaccessible cradle for the young, who are for a long time helpless. The birth may occur in any month, but the commonest time seems to be about mid-winter. The young ones are born blind and downy, and they cry a great deal. The mother will hardly leave them save on hasty rushes after the food necessary to keep up the supply of milk. When the cubs open their eyes, after about 35 days, the mother cautiously carries them out to bask for a while in the winter sunshine. Even before the young one can see, the mother may carry it in its mouth in the water, perhaps shifting from a threatened nest to a safer one. The number in a litter rarely exceeds three, and there may be only one.

Education of the Young.—This is a case where the small size of the family is compensated for by the good send-off in life that is secured. According to Mr. Tregarthen and others, there is more than maternal care, there is a detailed education of the young by the mother. This is a fact of considerable importance, for it indicates that survival depends not only on individual learning but on parental instruction as well.

When the cubs are able to clamber about, they are taught what may be called the " woodcraft " of the immediate vicinity of the " hover." They learn the alphabet of sounds, some indicating danger and some not. It has been observed that the mother punishes disobedient foolhardiness—especially on the part of male cubs. Yet she is a playful mother, sharing in the frolics of her children. Young otters are among the most delightfully playful of animals, and the significance of this is threefold. Play is a safety valve for overflowing energy and spirits; it affords opportunity to express and test originalities (variations in behaviour) if the young creature has any; and it is a not too responsible apprenticeship before the serious business of life begins. Play is the young form of work. What is particularly striking in the case of the otter is that the play period is greatly prolonged. " Even the fathers and mothers of families cannot resist the appeal of situations that suggest a frolic, and they will play up to the very gates of death."

The young cubs show some reluctance to take to the water—an interesting indication of the secondary nature of the otter's aquatic habits. But the cubs have no choice, for soon after

they can see and are able to follow the mother afield—perhaps two months old—they are taken to a quiet pool and taught to swim and dive. After about a week's teaching, it is said, the cubs can swim like fishes.

According to the expert observers, the young cubs have also to learn to like the taste of fish, to catch them without fumbling, and to eat them in the proper way—the eel from the tail and the trout from the head. They have to learn how to catch frogs in the quag and to take off the unpalatable skin. They have to learn to guddle for trout and eels; how to detect the plaice in the shallow waters of the bay, hidden in or against the sand with only their eyes showing. They have to learn how to deal with rabbit and moorhen, snake and mussel. They have to practise the diverse ways of lying *perdu* in and out of the water. Also, through it all, they have to keep working away at the long alphabet of danger-sounds—especially those proceeding from man and dog.

The otter has not much to do with agriculture, but it has its share in the balance of Nature, and it is a peculiarly instructive creature. It helps us greatly to a Darwinian grasp of the breadth and depth and subtlety of the struggle for existence. When we ask how the otter survives in an inhospitable country like Britain, we have to recognise that this depends on much besides the animal's natural gifts of strength and agility, keen senses and good brains. The otter's survival depends in part on the very careful mothering, on the detailed education that results in a resourcefulness that can hardly be baffled, and on the roving disposition which becomes expressed in an unrivalled elusiveness. Long live the otter!

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TRIALS OF SPRING CABBAGE IN NORTHUMBERLAND.

CHAS. W. MAYHEW,
County Instructor in Horticulture.

THE spring cabbage is one of the important and often most remunerative of market garden crops, but the rapidity with which it loses condition after being cut necessitates production within reasonable distances of the markets. Fortunately its adaptability in respect to soil and climate, is, within the range of the numerous varieties, very great. An evolved form of the wild cabbage (*Brassica oleracea*), and long known to cultivation, its chief characteristics are freedom from " bolting "

—*i.e.*, running to seed—hardiness, and rapid hearting. As already mentioned, it exists in numerous varieties, and one of the main objects of the trials dealt with below has been to demonstrate which varieties are most profitable for production in Northumberland.

Spring Cabbage Cultivation in Northumberland.—The sole aim of the cabbage grower in Northumberland is to supply the populous mining and industrial areas of the north-east of England—only on rare occasions has it been found worth while to send cabbages farther afield. The principal present areas of cultivation are to be found around Morpeth, and in the Tyne Valley at Wylam, Corbridge and Hexham. Morpeth is the Evesham, so to speak, of the north-east. Probably over a thousand acres of market gardens exist within the precincts of the ancient borough. Brassica constitutes the principal crop and the spring cabbage is grown to perfection. Readers of more southerly climes will be impressed most of all perhaps by the early date of sowing this crop—from the 10th-15th July. As may be imagined, forward plants are available for planting out at the beginning of September, or, as last year, earlier. Experience shows this to be the true way to get an early cut. The plants often look large and unduly forward at the beginning of winter and may come in for some rough handling in the event of severe weather, but they are there in the spring, strongly rooted, and ready to jump into growth at the first spell of favourable weather. Practically all of the spring cabbages grown are from home-saved seed. A fairly large, second-early type is preferred. The small quick-hearting forms such as Ellam's Early Dwarf and Harbinger are almost entirely taboo at present, being found uncertain in constitution. In selecting plants for seed production those conforming most to type are marked with a stick; the head is cut and marketed, and the sprouted stump eventually removed to flowering quarters. Since this is done by quite a number of neighbouring growers many might wonder how they manage to keep their respective strains distinct. It is, however, explicable by reason of the fact that there is no great difference between them in the first place.

Soil, Manuring, and Planting.—The light, warm and earlier soils are naturally favoured for spring cabbage culture, but some of the stiffer lands have been rendered comparatively light and suitable by long cultivation and manuring. With

regard to the latter, the growers would seem to err on the side of prodigality so generous are the dressings. An application of 50 tons per acre is not infrequent. This is not, of course, farmyard manure, but town material in which midden refuse often bulks largely. Notwithstanding, the growers do not stint the crop, and it is undoubtedly a wise policy. Rotation is scarcely thought of, and judging by results would appear unnecessary from a production standpoint. Planting, done by girls, is very close—some growers, working with a type which produces only a few outer leaves, plant at little more than a foot apart each way. Sixteen inches by fifteen is, however, a more general spacing. Care is taken to keep the crop clean, hand-weeding even being resorted to for this purpose in early spring. A spring stimulant is believed in and usually takes the form of a dressing of sulphate of ammonia at about 3 cwt. per acre applied by hand close to the plants comparatively early in the year—March being the usual time.

Cutting does not commence usually before mid-April, and the bulk of the supplies are marketed in May and June. They are packed in crates, each containing about six dozen, and sent to market twice a week, *e.g.*, on Tuesdays and Thursdays. Only the best heads figure in the earlier consignment. Prices naturally fluctuate, but the normal experience is to start at 3s. per dozen and gradually decline to 1s. 6d. for the best stuff. Very few good heads fetch less, however, than 2s.

The Trials.—These were instituted in 1923 and had for their main object the testing under uniform conditions of soil, manuring, and cultivation, of a number of well-known varieties available from seedsmen, and some of the local strains. The writer acting with the approval of the County Agricultural Education Sub-Committee has been responsible for the organisation of the trials, and was fortunate in obtaining the assistance of two able and conscientious growers in Mr. J. R. Temple, of Morpeth, and Mr. J. Mordue, of Wylam, who undertook the work of cultivation at their respective centres. In practically every detail this was made to conform to that commonly adopted for the normal crop. The initial trial, ending in June, 1924, included 21 stocks, and demonstrated the general superiority of the local growers' strains. Among these were those of Mr. John Cairns with a cabbage known as "W. Y. Price's strain," and Mr. J. R. Temple with his own special selection. Other sorts which stood out prominently were Clucas' "Early Market," "First and Best," from the

same firm; "Early Offenham" from Messrs. W. W. Johnson, Boston, and "McEwan's Early" from Dobbies, Edinburgh.

The second trial, 1924-25 was almost a replica of the first, except that 25 stocks were involved, and, of these, eleven were being tried for the first time. The sowing date for both Morpeth and Wylam was 16th July, 1924. Planting out was done on 5th September at Wylam and 9th September at Morpeth, at approximately the same distances, viz., 16 in. by 15 in. at Morpeth, and 14 in by 14 in. at Wylam. The plants were hoed at both centres in March and nitrogenous salts applied at the end of that month. The plots at Wylam were 1/169th acre in extent, containing originally 180 plants, and at Morpeth 1/22nd acre containing 1,100 plants for each variety. A public inspection (attended by over 60 growers in the case of Morpeth) was held at each centre at the beginning of June. Apart from this the writer paid visits for observation purposes throughout the period of the trials. In both seasons the plants got a good start, but whereas the winter of 1923-24 was marked by considerable severity, that of 1924-25 was exceptionally mild. Only at one period, the second week in March, were the plants subjected to anything like a severe test. Consequently the spring cabbage season for 1925 has been one of the earliest on record, considerable quantities being marketed from the fields in Good Friday week.

Results.—The varieties as a whole have given better results this year than last year. It is interesting to note that those varieties which stood out well in 1924 again gave a demonstration of their merits. The W. Y. Price strain, although eclipsed on the present occasion by two other sorts, has maintained a good position, as also have Mr. Temple's strain, Clucas' Early Market, and McEwan's Early. Mr. F. Lowrison's strain and Toogood's Nonesuch were noteworthy for their evenness, size and quality. That there are other good kinds the tabulated results show. The latter are based on counts and the valuation of independent valuers at each centre. Although the two centres had their own valuers it is interesting to note confirmatory valuations especially in respect to the leading varieties. Where discrepancies occur, it will be found mainly in respect to some of the small-hearted type such as "Early Wonder," Smurthwaite's strain, and Mordue's strain (medium size). These were decidedly more forward at Wylam than at Morpeth.

Northumberland Spring Cabbage Trials, 1925.

Order of Position	Variety or Strain	Bolts: Morpeth §	Bolts: Wylam ‖	No. ready to cut June 3rd *: Morpeth	No. ready to cut June 3rd *: Wylam	Value: Per doz. ‡	Value: Morpeth Total (£ s. d.)	Value: Wylam Full † Crop (£ s. d.)	Value: Average (£ s. d.)
1	F. Lowrison's (Hepscott) Strain	–	2	132	149	2/6	1 7 6	1 8 0	1 7 9
2	Toogood's Nonesuch ...	3	–	108	146	2/3	1 0 3	1 6 0	1 3 1½
3	W.Y. Price's (Morpeth) Strain	1	–	117	138	2/-	19 6	1 4 0	1 2 0
4	Temple's (Morpeth) Strain	–	–	125	123	2/-	1 0 10	1 2 0	1 1 5
5	Clucas' Early Market ...	–	–	108	114	2/3	1 0 3	1 0 0	1 0 1½
6	McEwan's Early (Dobbie)	–	–	109	130	2/-	18 2	1 2 0	1 0 1
7	Beefheart (Carter's) ...	3	6	80	138	2/3	15 0	1 4 0	19 6
8	Yate's Evesham	1	–	130	92	1/9	18 11½	18 0	18 5¾
9	Offenham (Stoke's) ...	–	–	112	108	2/-	18 8	18 0	18 4
10	First and Best (Clucas') ..	1	3	92	133	2/-	15 4	1 0 0	17 8
11	Finney's Wonder	2	1	69	144	1/9	10 0¾	1 2 0	16 0
12	Smurthwaite's Strain ...	–	2	68	137	1/9	9 11	1 2 0	15 11½
13	Johnson's Offenham ...	–	–	111	119	1/6	13 10½	18 0	15 11¼
14	Ord's (N. Shields) Strain ...	–	1	84	129	1/9	12 3	18 0	15 1½
15	Mordue's (Wylam) Strain...	2	1	77	121	1/6	9 7½	1 0 0	14 9¾
16	Market Favourite (Finney)	–	1	70	122	1/6	8 9	1 0 0	14 4½
17	Pringle's Imperial ...	1	–	96	116	1/9	14 0	14 0	14 0
18	Spring Beauty (Bath) ...	–	2	84	116	1/6	10 6	17 0	13 9
19	Harrison's Offenham ...	–	–	94	120	1/2	9 1¾	18 0	13 6¾
20	Flower of Spring (Sutton's)	3	3	93	132	1/3	9 8½	17 0	13 4¼
21	Early Kent (Harrison's) ...	6	10	33	112	1/-	2 9	18 0	10 4½
22	Ellam's Early (Ord) ...	4	17	52	120	1/-	4 4	15 0	9 8
23	Clarke's Triumph	7	15	53	90	1/6	6 7½	12 0	9 3¾
24	Carter's Springtide ...	18	12	37	88	-/9	2 3¾	13 0	7 7½
25	Victoria (Harrison's) ...	54	30	50	77	1/3	5 2½	10 0	7 7¼

* Out of 220 plants at Morpeth and 180 at Wylam.
† This valuation included the number ready and all others.
‡ At Morpeth. § Out of 11,00. ‖ Out of 180.

Classification.—The external features of a cabbage offer little reliable material on which to base a classification or establish relationships. There is, moreover, considerable confusion as to what is meant by a certain name. The three "Offenhams" in the trial presented distinctive features as between one and the other, the Lincolnshire strain being specially distinct in its compact shape, medium size, and deep green colour, as compared with the larger and lighter coloured strains from the Midland and Western areas of England. "Ellam's Early" is quite distinct in its small size, and very early hearting qualities. Next in size in an upward trend are "Early Wonder," "Smurthwaite's strain," "Early Kent" and "Springtide." We then come to the medium to fairly

large Offenham strains, allied to which are many of the leading local strains—Early Market, Early Evesham, and McEwan's Early. The growing of seed at different places throughout the British Isles will always render standardisation impossible. Soil, climate, and the human factor will always exert varying influences on the very susceptible constitution of a cabbage. It is at this juncture then that the value and importance of local trials can be emphasised. Nor should they be spasmodic in occurrence or final in effect. Practically every distinct geographical area should be steadily and continuously testing current varieties offered to the public. The economic value of the trials is enormous if one compares the returns of the different varieties or strains, and it is just as easy to grow a " winner " as a " loser."

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NON-RETURNABLE PACKAGES FOR APPLES.

It has frequently been suggested that a cheaper non-returnable package for apples, particularly cooking apples, is required. It is a simple enough matter to design ideal packages, but the cost is prohibitive. Enquiries have therefore been made by one of the writers into the present cost of packages of various shapes and sizes and made of various materials. The primary object of the enquiry was to ascertain the cheapest kind of package suitable for one and a-half bushels, but other packages have also been considered.

It is desirable that any such package should be suitable both for packing in an orderly manner and for simply filling in. The best method of packing high-grade apples is that which is known as the " diagonal pack " and, for reasons already given in a recent article* (in this *Journal* for June last). This necessitates a package which is approximately square in section across its length. Such a package may be filled either from the side or end and will give the correct height of pack automatically. The " ring pack " is also satisfactory for comparatively short distances and requires a circular package. In order that the same package may be used for lower grade apples, which are simply filled in, it should be tall in proportion to its width.

* This *Journal*, June, 1925—Apple Packing, by J. Stoddard, J. Turnbull and A. Whiting.

Bushel Box.—The cheapest material of which moderate quantities of the British Standard box can be made is imported timber cut in England and this can be obtained for 7½d. per set—sometimes less in the early summer. To this must be added 1d. for railway carriage and nails and ½d. for labour of making up. The total cost to the grower is thus 9d.

There is also on the market a bushel box made of veneer, which costs 9d. delivered (Fig. 4). As sent out in the past its shape has not been suitable for the diagonal pack, but it can be supplied at the same price with an internal measurement of 11½ in. by 11½ in. by 18 in., which gives a bushel capacity on the diagonal pack without any bulge. This shape is as suitable as the present shape for filling in.

Barrels.—Second-hand grape barrels, frequently known as kegs, and holding approximately a bushel and a-half, are largely used in the provincial markets—generally as returnable packages. The cost of new packages of this type is about 2s. 4d. Danish butter barrels (which are similarly used, though to a less extent) are about the same size and cost about 2s. 5d. to 2s. 7d. at the coopers in Denmark. This cost is made up of shaped heads and staves of Danish beech 1s. 8u., hoops 4d. and labour of assembling 4½d.

The cheapest method of making barrels here on a fair scale would be to purchase imported prepared heads and staves which would cost 1s. 3d. for 1½ bushel, 1s. 6½d. for 2 bushel and 1s. 8d. for 3 bushel size, all c.i.f. London. To these prices would have to be added railway carriage, cost of hoops and labour of assembling. Detailed enquiry has not been made into these, but in the country would probably bring the total cost up to fully 2s. for the 1½ bushel, 2s. 4d. to 2s. 6d. for the 2 bushel and about 2s. 9d. for the 3 bushel size.

Fibre barrels are considerably used, but cost 2s. 6½d., 3s. 4d. and 3s. 9d. for the sizes mentioned above. One firm of coopers produced a barrel made of plywood, which made an almost perfect package, but it was to cost about 2s. 7d. for the 2 bushel and 3s. 6d. for the 3 bushel size.

Wooden Case.—Various specifications have been worked out for a case to hold 1½ bus., and the lowest quotation that has been obtained is for English cut imported timber at 11d. per set. To this would have to be added at least 2d. for carriage, nails and making up, which brings the total cost up to 1s. 1d. This is for 5/16 in. sides, 2 in. by 9/16 in. battens and various thin ends. The tallest practicable shape is about 1 ft. square

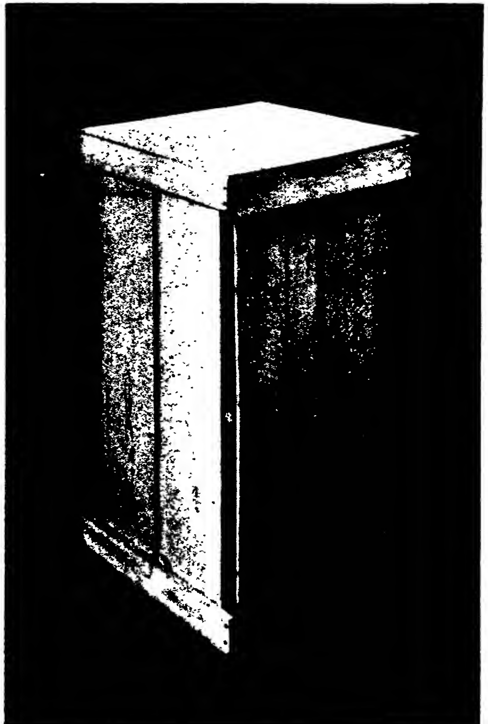

Fig. 1.—Wooden Case to hold $1\frac{1}{2}$ bushels.

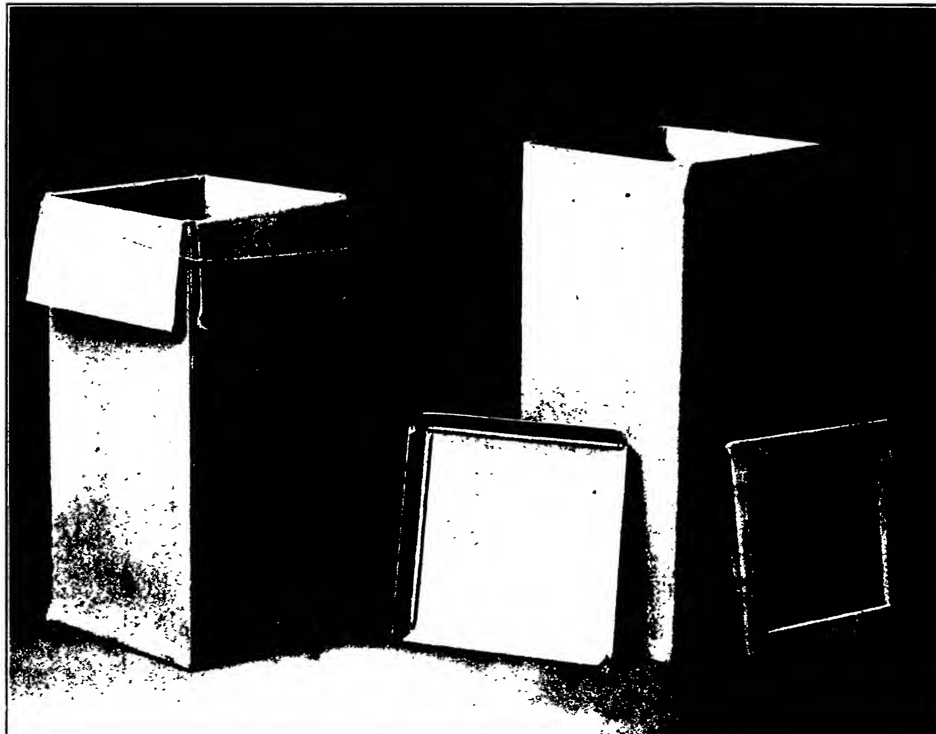

Fig. 2.—Waterproof Leatherboard Containers to hold $1\frac{1}{2}$ bushels.

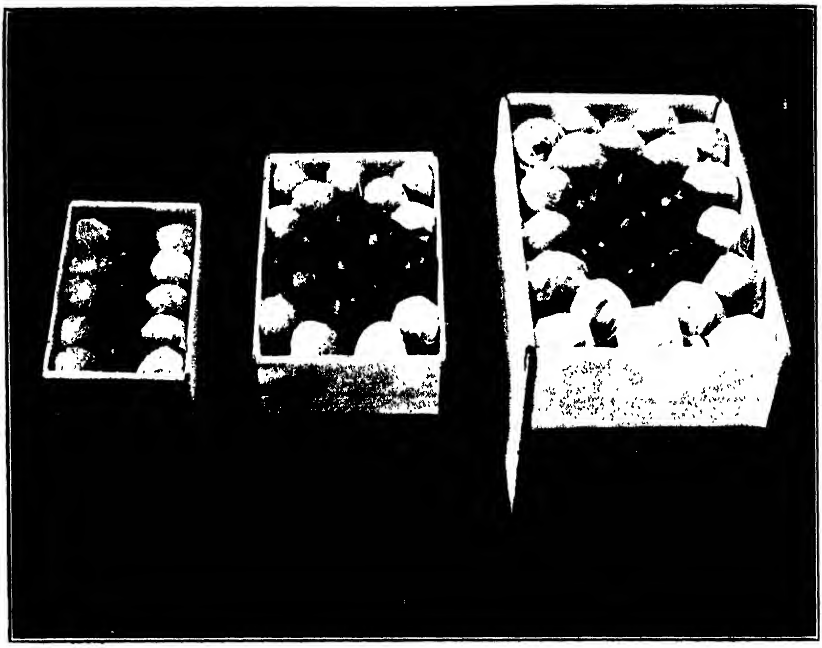

Fig. 3. Wooden Boxes. Left to right, ¼ box; ½ box, and bushel box.

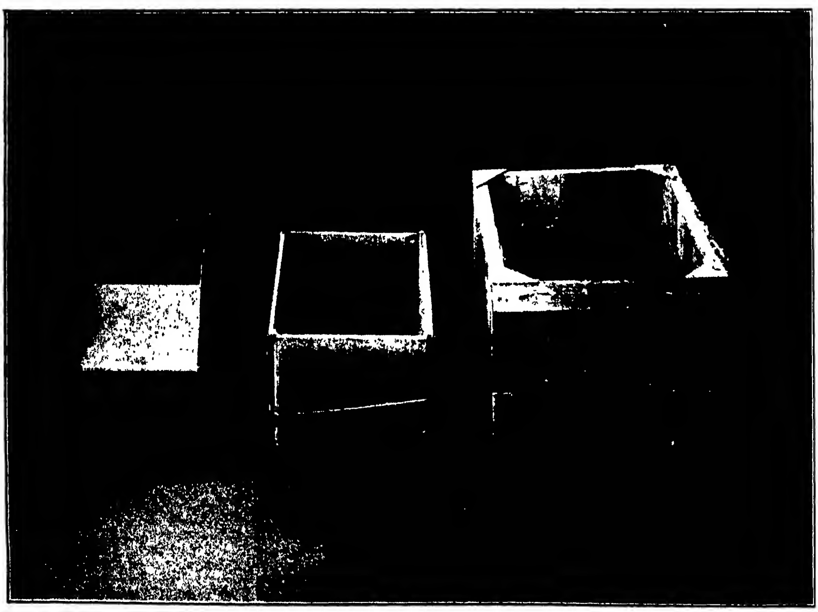

Fig. 4.—Left to right, ¼ box in fibre-board; ½ box in fibre-board, and bushel box in veneer.

and 2 ft. high. With 5/16 in. sides of this height, there is a slight bulge. The ends may be nailed on the outside with battens, or without if plywood is used, as shown in Fig. 1. This has the advantage of making a very strong package. If it is desired to have an adjustable end, so as to be able to press it down and secure a tight pack, a thin end held in place by battens might be used, but they would give no strength to the package which would easily come apart. Thicker ends, which could be nailed into through the battens and sides would need to be at least 7/16 in. thick—which would add about 1d. to the cost. Experience with this type of package would probably show that the best shape would be 14 in. square and 18 in. high.

The possibility of reducing the cost of this package by using thick veneer as seen in some American packages has been considered, but apparently the cost of the knotless wood required would be prohibitive in this country.

Manufactured Boards.—Best quality waterproof leather-board, known as containerboard, costs about £17 10s. per ton. About 5 lb. is required to make a 1½ bus. package, and the cost of material would be over 10d. (after allowing for waste in cutting). Expensive machinery is also required for cutting, folding and stitching. The quotation for a complete package is 1s. 3d. to 1s. 5d. delivered.

There is a cheaper class of material known as fibreboard. Rectangular packages made from this are shown in Fig. 2. The type with turned back ends costs from 9d. to 9¾d. delivered, to which must be added cost of gluing ½d., making a total of 9½d. to 10¼d., according to quantity. The type with wood frame end, also shown in Fig. 2, costs 11¾d. to 1s. 0¾d., plus nails and labour ¾d., total 1s. 0½d. to 1s. 1½d., or about the same as an all wood case. Instead of the wood frame ends, fibre-board ends as shown might be used. The cost would then be 9½d. to 10¼d. plus ¼d. for stitching, making a total of 10d. to 10¾d. In this case a good stitching machine costing £10 would be required, as the boards are thick and it requires considerable pressure to pierce them.

These seem to be the cheapest packages available and owing to their light weight, the saving in railway carriage is considerable, but trial is necessary to ascertain whether they are strong enough to protect the contents and withstand rough usage—and also whether they meet with approval in the market.

Cylindrical Packages.—These might conveniently be made out of manufactured boards or plywood. It is understood that the " drum " used for Canary bananas, which is made of container boards with wood frame ends, costs as much as a wooden package and is used for technical reasons which do not apply to our apples. This is borne out by the costs of rectangular packages given above. It is possible that the cost of this package might be lowered by making it entirely of fibreboard, but machinery does not seem to be available for making suitable one piece ends in such a large size.

Third quality thin plywood costs 10s. 6d. per square and is generally sent in pieces 5 ft square. Sufficient for a 1½ bus. package would cost 1s. 3d. or 1s. 4d., to which must be added 2d. or 3d. for making up with bands and nails. Rejected material may be obtained at a cheaper rate, but it would not have to cost more than half of this to be worth considering.

1½ Bushel Packages.—The following is a summary of the cost of the various packages considered :—

Package.	Weight.	Price.	Extras.	Total.	Cost per bushel.
	lb.	s. d.	d.	s. d.	s. d.
Barrel Wood	14	1 3	9	2 0	1 4½
" Fibre	—	2 6½	...	...	1 8½
" Plywood (2 bus.) ...	—	2 7	...	...	1 3½
Case Container board ...	5	0 10	6	1 4	0 10½
" Fireboard and wood	5	1 0	¾	1 0¾	0 8¾
" " fibre ends ...	4	0 10	½	0 10½	0 7
" " one piece ...	5	0 10¼	½	0 10¾	0 7¼
" " (in quantity)	—	0 9½	½	0 10	0 6¾

It appears from the above that the cheapest package is made entirely of fibreboard. It has the advantages of being light, collapsible and pilferproof. Packages made from similar material were tried many years ago and failed, but the design and method of making up (on which the strength largely depends) were different. Nothing but trial will decide whether they are suitable or not, and they will be tried during the coming season.

Next to these the cheapest 1½ bus. package is the sawn wood case. Even this costs as much in proportion as the bushel boxes first mentioned.

Half Box.—High-class dessert apples such as Cox's Orange Pippin, of grades not quite good enough for single layer boxes require a smaller package than the British Standard Box. A

half bushel box suitable for packing diagonally should be 9 in. by 9 in. by 14½ in. inside. A wooden box to the following specification :—

Ends	2 pieces	9 in. x 9 in. x 7/16 in.
Top, bottom and sides	8 „	15⅝ in. x 4½ in. x 3/16 in.
Battens	4 „	8¾ in. x ¾ in. x 3/16 in.

costs about 5d. plus ¾d. for carriage, nails and making up: total 5¾d. A box of similar size and shape may be made of fibreboard, and would cost 4½d. to 5d. plus ½d. for gluing: total 5d. to 5½d. according to quantity (Figs. 3 and 4).

Quarter Box.—This should be useful in developing the sale of packages intact or for direct trading. Such a box suitable for packing diagonally should be 7 in. by 7 in. by 12½ in. inside. A wooden box to the following specification—

Ends	2 pieces	9 in. x 9 in. x 7/16 in.
Top, bottom and sides	8 „	13⅜ in. x 3⅜ in. x 3/16 in.
Battens	4 „	6¾ in. x ¾ in. x 3/16 in.

costs about 3¾d. plus ¼d. : total 4d. A fibreboard box of similar size and shape costs about 2½d. to 3d. plus ¼d., total 2¾d. to 3¼d.

The tomato box is a cheaper box, costing only 2¾d. in the flat or 3¼d. made up (owing to the very large quantity made), but owing to its shape, it will only accommodate apples of 2 in. to 2¼ in. diameter on the diagonal pack.

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DEPOSITS OF ARSENIC AND COPPER ON EATING APPLES.

FRUIT growers now make a practice of spraying fruit trees with liquids containing poisonous chemicals, and those containing copper, arsenic and lead compounds are used quite frequently. In this country such sprays are applied when the blossoms are in the pink bud stage, and sometimes again immediately after the petals have fallen, and in some cases perhaps even a little later. In America, sprays are applied at similar times, but additional sprays are used and the last may be applied even 12 to 14 weeks after the blossoming stage. The growers find these sprays necessary to keep down pests, which, if allowed to develop, would blemish the fruits. The idea of using poisonous chemicals on fruit may appear to be unsafe, since fruit is eaten in the unwashed state and often unpeeled, and it is not surprising that many members of the

consuming public point to this matter and ask for assurances that harm cannot result. Frequently, anxiety has arisen where people have purchased imported apples and noticed in the depressions surrounding the eye and stalk of the apples a thin film of greenish powder—probably copper arsenate. Apples bearing these greenish deposits are now so common that some Members of Parliament have asked questions in the House of Commons as to the danger of using such sprays, and journalists have been stimulated to write condemnatory articles in the public and trade press.

An inquiry into the matter was therefore desirable, and the Ministry accordingly arranged for members of its horticultural inspectorate to purchase apples which were known to have come from three distinct and different sources:—(*a*) From English orchards; (*b*) from Canadian orchards; and (*c*) from American orchards. It was known that spraying had been done in the English orchard but there was no information available to show whether sprays had been used in the other orchards.

The samples, numbering 24 in all, and each consisting of about five apples, were tabulated separately and submitted to Sir R. Robertson, the Government chemist, for analysis, with the results shown in the following table.

Sir R. Robertson reports that for the purpose of analysis the flesh of the apples was rejected, and the examination confined to skin, stalk and calyx, since previous work had shown poisonous metals to be unrecognisable in the flesh of apples even when ponderable amounts were present on the skin.

Arsenic.—Eleven of the samples were free from arsenic, nine contained traces, and four contained proportions a chemist would consider to be appreciable. Only one of these four contained more than 1/100th grain per pound, the limit suggested by the Royal Commission on Arsenical Poisoning in 1903, the actual proportion found in this sample being equivalent to 1/55th grain of arsenious oxide in a pound of apples. The medicinal dose of arsenic given in the British Pharmacopœia, 1914, is 1/64th to 1/16th of a grain. A consumer of such exceptional apples would therefore have to eat more than ½ lb., including peel, stalk and calyx to get a minimum pharmacopœial dose, and about 2½ lb. to get a maximum pharmacopœial dose.

LEAD, COPPER AND ARSENIC ON APPLES BOUGHT BY THE MINISTRY.

No.	Source.	Total found on surface per pound of apples.		
		Lead Grains.	Copper Grains.	Arsenic Grains.
1	Devon	0.0004	none	none
2	Nova Scotia	0.0007	none	trace
3	U.S.A.	0.0003	none	trace
4	Nova Scotia	0.0004	0.0024	trace
5	U.S.A.	0.0022	0.0017	0.0009
6	U.S.A.	0.0057	trace	0.0035
7	U.S.A.	0.0007	0.0014	0.0019
8	Canada	0.0009	0.0025	none
9	British Columbia	0.0007	0.0007	none
10	British Columbia	0.0349	0.0006	0.0182
11	Nova Scotia	0.0004	0.0011	none
12	Lancashire	0.0003	0.0015	none
13	Not stated	0.0011	0.0046	none
14	Purchase at Capel Curig	0.0037	0.0084	trace
15	Yorkshire	0.0010	0.0027	trace
16	Not stated	0.0006	0.0035	trace
17	Worcester	0.0003	none	none
18	Kent	0.0001	none	none
19	Cambridge	trace	0.0016	trace
20	Cambridge	none	0.0005	none
21	Cambridge	none	0.0010	trace
22	Cambridge	0.0002	none	trace
23	Cambridge	0.0002	none	none
24	Devon	0.0010	0.0027	none
	Average	0.0023	0.0015	0.0010

If the apples were eaten with their skins on but without the calyx, stalk and the small amount of peel near them, then these weights of apples would need to be doubled to get the respective pharmacopœial doses, since it was shown that one-half the total arsenic was localised around the stalk and calyx.

It may be of interest to compare the following maxima expressed as decimal fractions of a grain of arsenious oxide per pound of material, and found—

Upon the apples mentioned above	0.018
In Whitstable eating oyster meats ("Fishery Investigations," Series II, Vol VI, No. 4. 1924, p. 48)	0.025
In the edible part of plaice ("Analyst," 1925, p. 10)	0.021

Lead.—Two lots of apples were entirely free from lead; one contained a trace that could be recognised but scarcely determined quantitatively; and twenty contained measurable though minute quantities ranging from 0.0001 to 0.0057 grain expressed as metallic lead in a pound of apples. The sample which was exceptional in its arsenic content was also exceptional in its lead content: the proportion being 0.0349 grain per pound. About 16 lb. of apples would have to be consumed, with skin, stalk and calyx, before a minimum pharmacopœial dose of lead would be taken.

Copper.—Seven lots of apples afforded no evidence of copper, but traces were found in the other samples. The maximum proportion was 0.0084 grain expressed as metallic copper in a pound of apples. According to Winter Blyth ("Poisons," p. 640) the ordinary daily food of an average man contains about 0.015 grain expressed as metallic copper, a quantity which would be found upon $1\frac{3}{4}$ lb. of apples like the sample containing the most copper.

Home-grown and Imported Apples.—It is a matter for serious consideration whether the home-grown apples which have been sprayed not later than May bore as much of the chemicals as those grown in the districts in the Pacific Coastal Regions of North America where spraying may be carried out as late as August. In all, 13 samples of home-grown apples were collected from orchards which had been sprayed with arsenate of lead twice (once in April and again in late May) in nine cases, and once only in two others, no information being available in regard to the remaining two. The average quantities found on the surface per lb. of apples were—

Lead *Grains.*	*Copper* *Grains.*	*Arsenic* *Grains.*
0.0004	0.0014	trace

In fact no arsenic was found on 8 of the samples and only a trace on the other 5. The amount of lead and copper present is too small to cause any anxiety, but it is somewhat curious to find copper present, since inquiries did not show that any copper spray had been used.

Eleven samples of apples grown in North America were found to bear lead, copper and arsenic on the surface, per lb. of apples, as follows:—

	Lead *Grains.*	*Copper* *Grains.*	*Arsenic* *Grains.*
U.S.A. (5 samples)	0.0025	0.0023	0.0013
Canada (6 samples)	0.0063	0.0012	0.003

Though these amounts are larger than those found on the home-grown fruit they are still too small to cause any anxiety. The average figures for the Canadian-grown apples probably give a wrong impression, for in five cases the amounts were very low but in the case of some "Jonathans" from British Columbia they were unduly high, probably indicating that the spraying there took place at a later stage when the apples were well developed and that no rains came later to wash the fruit before it was gathered. It is evident from this one case alone that apple growers may have to give up the abnormally late spraying or use some less obnoxious poison than the stable lead arsenate.

The results of the other twenty-three cases show that the total amounts of arsenic, lead and copper present were too small to be regarded as harmful even though the whole of the apples had been eaten.

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SEPTEMBER ON THE FARM.

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Weather Notes.—September is the first month of the autumn quarter; its normal weather characteristics, however, resemble those of summer rather than those of the next two months. The day temperature in the Midlands generally rises to about 65° F., and the mean night temperature is about 52° F.; but towards Michaelmas night frosts begin to occur in most districts, showing their effects on the more sensitive plants, such as nasturtiums, runner-beans and potatoes; and the evening mists hanging over low-lying grass fields serve to remind the farmer about the husk worm, which may affect his young stock if still lying out at night on such land. The normal rainfall in September is comparatively low; but occasionally, as in 1918 and no longer ago than last year, this may be a cloudy, wet month, during which corn sheaves dry tardily and stubble cleaning is impossible on any but light soils.

Field Operations.—Harvest work commonly extends past the middle of September, and later in upland and northern districts. Here the corn frequently is unripe at the end of the month, and when cut while still green and sappy, it is allowed to complete its drying by being left in the field in small conical stacks. This year appearances point to the possibility of the hill corn crops attaining yellow ripeness, which is an advantage in that ripe

corn can be secured with less difficulty than green grain. More use might, however, be made of the proved early ripening sorts of oats, such as Dala and Superb, and of the fact that winter oats can be grown successfully to ripen in August at high altitudes, if sown in January and February.

Hedges between arable fields are properly kept short and, of course, clean and free from weeds in the bottom. The requisite thorough bottom cleaning is generally done when the field is under fallow crops, attention being given to the headlands and hedge bottoms as soon as possible after the root crop has been singled and horse hoed. The annual brushing of the hedges is often conveniently done immediately after corn harvest. At this time the thorn is still in full leaf, when the shoots are easier to cut than they are after the sap has gone. It cannot be denied, however, that repeated cutting in August or September tends to weaken the growth of the quick.

The correct order of attention to the different sections of the arable land in September depends on the actual rotation of crops practised. Where little autumn-sown corn is grown, operations may be concentrated on cleaning and, perhaps manuring the stubbles intended for green crops next year. Where winter corn is sown, however, priority is properly given to the preparations necessary for drilling the crops which should be sown in October, such as winter beans, winter oats, and wheat after "seeds" and bare fallow.

Wheat.—Provided that the seed bed has been suitably prepared and that excess of seed is not used, early sowing is an important factor in the production of good crops of wheat. The influence of time of sowing is illustrated in a very clear and interesting fashion at Reading, where for some years Professor Percival has sown a row of wheat every week in succession throughout the year. The plants sown in May and June do not produce ears until June of the next year; July and August sowings behave similarly; the rows sown in September and October, however, show stronger growth and better heads than those sown earlier or later. In the rows sown after the end of October there is a progressive decline in the vigour and ear-forming power of the plants until, in the April and later sowings, merely leafy growth continues for the remainder of the summer. Incidentally, other experimenters have found that if spring oats or barley be intersown with wheat in May, the wheat will behave like rye grass, heading out in June of the following year.

Early sowing is possible after bare-fallow, of which there were 462,800 acres in England and Wales on 4th June of the present

year. After bare-fallow, early sowing is desirable not only because it conduces to a full yield and allows of the saving of about 4 stones of seed per acre, but also because in this case delay may result in the land becoming too sodden to carry the teams at drilling. A period much favoured for the drilling is between 20th September and 1st October; but in some districts even earlier sowing may be practised. The chief risk with very early sowing is that in a mild winter the crop may become " winter proud ", the effects of which are most visible when too much seed has been used. Bunt or stinking smut is also most troublesome in early-sown crops, but this may be effectively and very cheaply prevented by dressing the seed with formalin solution. As a rule wheat after fallow is a safe crop; but recent investigation has shown that the wheat bulb fly results in considerable loss of plant during the winter in some districts. Land that has been bare fallowed is apt to lie rather wet at the surface during the winter, especially where the surface is level and too fine a tilth has been made. Rounded lands and a somewhat cloddy surface facilitate drainage and thereby prevent loss of plant by drowning and throwing out by frost. As regards varieties, stiff strawed sorts such as Yeoman, Iron and even Rivett's may be chosen with advantage, the first where quality pays, and one of the other two where, as in many districts, poultry corn is worth more than wheat of good milling quality.

Where wheat follows lea, early sowing is not as a rule practicable. The lea furrow requires a period of several weeks in which the turf may decay and the soil become mellowed and sufficiently moistened for the proper germination and development of the wheat. The grass should first be well grazed down and the furrows either heavily rolled or furrow pressed to obtain the necessary consolidation. Where the lea is in any degree infested with twitch, however, the surface layer must be skimmed off and worked out before ploughing. The latter method is much practised where the lea cannot be ploughed until September; but, as recent work on the frit fly has shown, there is risk attached to the sowing of corn in autumn after grassy leas which have not been ploughed before this month. Cases are on record of good results having been obtained where the lea stubble has been skimmed off, worked out and carried away, and the wheat drilled in the shallow mould without reploughing.

Most of the above remarks apply equally to winter oats. White winters possess very strong straw and exceptionally heavy

cropping powers on land in good heart. In the winter of 1923-24, however, this variety failed badly in the midland and northern counties. One of the most successful crops, in a district where failure was general, had the advantage of being drilled on 25th September.

Stubble Cultivations.—On feeding farms the consolidated manure is left undisturbed in the fold yards until about this time of the year, when it is carted out and applied to the leas for wheat or to the stubbles for mangolds or potatoes. Manure carting and stubble cleaning both demand attention at the same time, and as the former occupies most of the men and horses, the assistance of a tractor tilling outfit is particularly valuable at this period.

Where potatoes occupy a regular place in the rotation between two corn crops, as in the Lothian six-course (turnips, barley, seeds, oats, potatoes, wheat), attention is first given to the oat stubble: the wheat stubble after potatoes is clean, whereas the oat stubble after seeds may contain some twitch. In the Lothians the yard manure is applied in autumn to the oat stubble for potatoes, and the manner of its application is worthy of mention. The field is first marked out in both directions with scratch lines $5\frac{1}{2}$ yards apart, forming squares of pole area, *i.e.*, 160 per acre. Each load of manure is then divided into the appropriate number of heaps, one heap per square. Thus in a 20-load dressing, each load must cover $160 \div 20 = 8$ squares. The marks also indicate the position of the ridges and furrows in the subsequent ploughing.

In the five-course rotation (roots, corn, lea, oats, wheat), it is sometimes difficult to decide whether to give first attention to the oat stubble or to the wheat stubble. The latter naturally contains most twitch; but if the oat stubble is to receive the requisite cleaning and manuring which good husbandry prescribes for a second straw crop, it must have early attention. The decision should depend on the land and on the crop intended. Where mangolds form part of the root break and the soil is heavy, probably the area intended for this crop should be dealt with first: mangolds are very intolerant of spring cleaning operations on heavy soil, and the crop is most reliable where the oat stubble has been cleaned and manured in autumn. Where ridge cultivation is practised, the ridges may be drawn out at this time of the year. The rest of the root break—for swedes, marrow-stem kale and cabbages—may well wait until the oat stubble has been prepared for wheat.

Live Stock.—September is the time when arable farmers begin to buy their winter stock of cattle and sheep to consume their roots and to tread down their straw. With light crops of roots and a shorter supply of straw, it is anticipated that the demand and the prices for stores will be correspondingly less than usual. Grass farmers who have land and fences suitable for sheep will doubtless consider the situation with a view to keeping a small flock of hoggs or a flying flock of ewes. There is no class of stock that has paid better in recent years than sheep well managed in winter on grass farms.

Milk Yields.—Notwithstanding the more skilful management required by high yielding cows, a herd average of 1,000 gallons of milk with a good fat content is the ideal after which the progressive dairy farmer is striving. Not many have attained it and succeeded in maintaining it for more than two years, and few if any can claim to have gained that measure of success with a home-bred herd of regular ages. Indeed, of the 138,984 cows officially recorded in the year ended 1st October, 1924, only 77 appear in the list of cows with Certificates of Merit in the Ministry's Register of Dairy Cattle (Vol. VIII), the qualification for the certificate being an output of 24,000-26,000 lb. of milk, according to breed, in three successive years, and not less than three calvings within the period.

It is obvious that a high milk yield involves the consumption of a correspondingly large quantity of foods; but there is ample evidence from actual experiments and ration records that abundant food or infinite care in feeding will not make up for the lack of an efficient udder: the first requisite is a cow possessing not only sufficient digestive capacity but also the necessary dairy temperament and milk manufacturing organs. "You can feed a cow until she bursts, but she will not make milk unless she has the inheritance for doing it." The desired type of cow is the product of parents which possessed active or latent dairy qualities. The milk-recording movement has for its object the encouragement of dairy farmers to breed from parents whose milk-producing ancestry has been demonstrated by actual measurement. The growing recognition of the value of the movement is indicated by the fact that during the year reviewed in Vol. VIII of the Annual Register, the number of members of milk recording societies increased by 401 and that 10,294 more cows were recorded than in the previous year. The next recording period begins on 1st October.

MONTHLY NOTES ON FEEDING STUFFS.

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The Use of Cocoa Shell Meal as a Feeding Stuff.—Quantities of cocoa shell meal are now reaching the market, and are being used as a feeding stuff for cows. A few remarks on the value of this material as a feeding stuff may be of value to farmers who wish to use it.

The fruit of the cocoa tree consists of a large pod, the interior of which contains a pulp in which are embedded 20 to 40 cocoa beans. These beans undergo a fermentation process, are heated to a high temperature, and by means of suitable machinery the kernel of the bean is separated from the shell. The outer husk or shell constitutes the by-product from which the cocoa shell meal is made. The feeding value of the cocoa shell meal varies with the treatment the bean receives during the preliminary treatments of fermentation and roasting, and it is therefore difficult to assess exactly the feeding value of different samples of cocoa shell meal. Cocoa shell meal is dark brown in colour, and is variable in composition. Available analyses show the following variations in composition:—Protein, 8.04 to 13.24 per cent.; fat, 2.8 to 8.6 per cent. (average about 3 per cent.); carbohydrates, 35.53 to 51.30 per cent.; woody fibre, 9.6 to 17.70 per cent.; and ash, 4.9 to 10.04 per cent. High ash content is associated with the use of an argillaceous earth in the preliminary preparative treatment of the bean. The ash contains a fair quantity of phosphorus and is particularly rich in potash and magnesium.

The differences in composition are also associated with differences in digestibility, the digestibility of the protein varying from 11 to 40 per cent. Two alkaloids are present in cocoa shell meal, theobromine and caffeine, the theobromine being present to the extent of 0.9 per cent. and the caffeine 0.5 per cent.

For Horses.—The presence of these alkaloids necessitates care in the use of the meal for stock feeding, and experiments in France during the war showed that it was inadvisable to give to horses more than 1¼ lb. of the meal per head per day, if untoward symptoms were to be avoided.

For Cows.—Experiments carried out with milch cows in Italy indicated that 2 to 6 lb. of cocoa shells may be given per head per day with useful results. Up to 10 lb. per head

DESCRIPTION.	Price per Qr. s. d.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv. s.	Price per lb. Starch Equiv. d.	Per cent of Digest. Crude Protein %
Wheat, British	—	—	12 5	0 14	11 11	71·6	3/3	1·74	10·2
Barley, British Feeding	—	—	10 5	0 11	9 14	71	2/9	1·47	6·5
„ Canadian :—									
„ „ No. 4 Western	40/6	400	11 7	0 11	10 16	71	3/1	1·65	6·5
„ American	40/6	„	11 7	0 11	10 16	71	3/1	1·65	6·5
„ Karachi	39/9	„	11 3	0 11	10 12	71	3/0	1·61	6·5
Oats, English, White	—	—	11 0	0 12	10 8	59·5	3/6	1·87	8·0
„ „ Black and Grey	—	—	10 10†	0 12	9 18	59·5	3/4	1·78	8·0
„ Canadian :—									
No. 2 Western	33/6	320	11 15	0 12	11 3	59·5	3/9	2·01	8·0
„ „ Feed	27/3	„	9 10	0 12	8 18	59·5	3/0	1·61	8·0
„ „ Argentine	28/3	„	9 18	0 12	9 6	59·5	3/2	1·70	8·0
„ „ Chilian	27/9	„	9 15	0 12	9 3	59·5	3/1	1·65	8·0
Maize, Argentine	46/9	480	10 18	0 12	10 6	81	2/7	1·38	7·1
Beans, English Winter	—	—	12 0†	1 9	10 11	67	3/2	1·70	20·1
„ Chinese „	—	—	11 2*	1 9	9 13	67	2/11	1·56	20·1
Peas, Japanese	—	—	26 0*	1 5	24 15	69	7/2	3·84	19·4
Dari, Egyptian	—	—	11 15	0 14	11 1	75·2	2/11	1·56	7·7
Millers' Offals :—									
Bran, British	—	—	7 2	1 4	5 18	45	2/7	1·38	10·9
„ Broad	—	—	8 15	1 4	7 11	45	3/4	1·78	10·9
Middlings—									
Fine Imported	—	—	9 17	1 0	8 17	72	2/6	1·34	12·6
Coarse, British	—	—	8 7	1 0	7 7	64	2/4	1·25	11·5
Pollards, Imported	—	—	7 10	1 4	6 6	60	2/1	1·12	11·6
Meal, Barley	—	—	12 5	0 11	11 14	71	3/4	1·78	6·5
„ Maize	—	—	11 15	0 12	11 3	81	2/9	1·47	7·1
„ „ South African	—	—	10 0	0 12	9 8	81	2/4	1·25	7·1
„ „ Germ	—	—	9 15	0 17	8 18	85·3	2/1	1·12	18·4
„ „ Gluten Feed	—	—	10 0	1 5	8 15	75·6	2/4	1·25	20·0
„ Locust Bean	—	—	9 15	0 8	9 7	71·4	2/6	1·34	4·0
„ Bean	—	—	13 0	1 9	11 11	67	3/1	1·65	20·1
„ Fish	—	—	20 10	3 17	16 13	53	6/3	3·35	50·0
Linseed	—	—	22 5	1 8	20 17	119	3/6	1·87	19·4
„ Cake, English 12% Oil	—	—	14 5	1 15	12 10	74	3/5	1·83	25·3
„ „ 10% Oil	—	—	13 7	1 15	11 12	74	3/2	1·70	25·3
„ „ 9% Oil	—	—	13 5	1 15	11 10	74	3/1	1·65	25·3
Soya Bean „ 6 % Oil	—	—	12 10	2 8	10 2	69	2/11	1·56	38·2
Cottonseed Cake, English 5½% Oil	—	—	8 5	1 12	6 13	42	3/2	1·70	17·6
„ „ Egyptian 5½% Oil	—	—	7 17	1 12	6 5	42	3/0	1·61	17·6
Decorticated Cotton Seed Cake 7% Oil	—	—	12 17†	2 9	10 8	71	2/11	1·56	34·6
„ „ Meal 7% Oil	—	—	12 12†	2 9	10 3	74	2/9	1·47	36.3
Ground Nut Cake 7% Oil	—	—	10 15†	1 13	9 2	56·8	3/2	1·70	27·7
Decorticated Ground Nut Cake 7% Oil	—	—	13 10†	2 10	11 0	73	3/0	1·61	42·0
Palm Kernel Cake 6% Oil	—	—	8 15	1 1	7 14	75	2/1	1·12	17·1
„ „ Meal 2% Oil	—	—	7 15	1 2	6 13	71·3	1/10	0·98	17·1
Feeding Treacle	—	—	7 2	0 8	6 14	51	2/8	1·43	1·1
Brewers' Grains :—									
Dried Ale	—	—	8 17	1 2	7 15	49	3/2	1·70	14·0
„ Porter	—	—	8 7	1 2	7 5	49	3/0	1·61	14·0
Wet Ale	—	—	1 5	0 8	0 17	15	1/1	0·58	4.8
„ Porter	—	—	1 0	0 8	0 12	15	–/10	0·45	4·8
Malt Culms	—	—	7 15†	1 11	6 4	43	2/11	1·56	19·9

* At Liverpool. † At Bristol

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of July and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 3s. per ton. The food value per ton is therefore £8 17s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices:—N, 11s. 7d; P_2O_5, 3s. 7d. : K_2O. 2s. 9d.

per day have also been given with favourable results in France. Careful experiments were carried out on this material by M. Lucas at Gournay Farm. In these experiments roughly 6 lb. of cocoa shells replaced 4½ lb. of grain, with the result that although the total yield of milk decreased in those animals fed on the cocoa shells, the total butter fat yielded was the same, since the decrease in total yield was associated with an increased percentage of butter fat.

For Sheep.—French experience has shown most favourable results with cocoa shell meal when it is fed to sheep. It is best fed mixed with forage in the proportion of ½ lb. of meal per head per day.

According to the above experiences with the use of cocoa shell meal as a feeding stuff, the following maximum amounts per head per day may be recommended. Horses, 1¼ lb.; cows, 6 lb.; sheep, ½ lb.

Valuation of Cocoa Shell Meal.—Owing to the differences, both in composition and in digestibility, it is difficult to assess or value cocoa shell meal. Kellner, from his experiments, assessed the feeding value of cocoa shells as equal to straw. Lindsey and Smith in America considered cocoa shells to be worth about half the price of maize meal, whereas the French experience quoted above would indicate that 2 tons of cocoa shells are equivalent in feeding value to 1½ tons of grain. Diverse though these opinions are, they are given here as some sort of guide to the farmer who contemplates using this material for feeding his cattle.

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FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat	1·38	2 7	71·6	9 5	0 14	9 19
Oats	1·38	2 7	59·5	7 14	0 12	8 6
Barley	1·38	2 7	71·0	9 4	0 11	9 15
Potatoes	1·38	2 7	18·0	2 6	0 3	2 9
Swedes	1·38	2 7	7·0	0 18	0 2	1 0
Mangolds	1·38	2 7	6·0	0 15	0 2	0 17
Beans	1·38	2 7	67·0	8 13	1 9	10 2
Good Meadow Hay	1·70	3 2	31·0	4 18	0 13	5 11
Good Oat Straw	1·70	3 2	17·0	2 14	0 7	3 1
Good Clover Hay	1·70	3 2	32·0	5 1	0 19	6 0
Vetch and Oat Silage	1·56	2 11	14·0	2 1	0 7	2 8
Barley Straw	1·70	3 2	19·5	3 0	0 6	3 6
Wheat Straw	1·70	3 2	11·0	1 15	0 4	1 19
Bean Straw	1·70	3 2	19·0	3 0	0 9	3 9

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	*Average Price per ton during week ending Aug. 12th.*				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	13. 2	13. 0	12.10	12.15	16. 5
„ „ Lime (N. 13 per cent.)	...	12.10	...	12.12	19. 5
Sulphate of Ammonia, neutral (N. 21.1 per cent.)	12. 5*	12. 5*	12. 5*	12. 5*	(N)11. 7
Kainit (Pot. 20 per cent.)	3. 2	3. 0	...	...	...
„ (Pot. 14 per cent.)	2.17	2.15	...	...	...
Muriate of Potash (Pot. 50 per cent.) ..	8. 5	7.10	...	...	...
Sulphate of Potash (Pot. 48 per cent.) ...	12.10	11.15	...	...	...
Basic Slag (T.P. 34 per cent.)	...	..	3. 0§	...	...
„ „ (T.P. 30 per cent.)	3. 3§	...	..	2.15§	1.10
„ „ (T.P. 28 per cent.)	2.10§	2. 5§	...	2.10§	1. 9
„ „ (T.P. 26 per cent.)	2. 6§	2. 1§	...	2. 5§	1. 9
„ „ (T.P. 24 per cent.)	...	1.17§	1.18§	...	...
Superphosphate (S.P. 35 per cent.) ...	...	...	...	3. 8	1.11
„ (S.P. 30 per cent.) ...	...	3. 2	...	3. 2	2. 1
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	8.15	8. 5	7.17	8. 0	...
Steamed Bone Flour (N. ¾, T.P. 60-65 per cent.)	6. 2†	6.10†	6. 5	5.10	...
Fish Guano (N. 7½-8½, T.P. 16-20 per cent.)	...	...	13. 0	...	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station. London prices are for 4-ton lots.

§ Prices include cost of carriage from works to town named. Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire and London prices are for not less than 4-ton lots delivered within a limited area. Cost to purchasers in other districts will be greater or less according to the distances of different purchasers from the works.

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MISCELLANEOUS NOTES.

Electro-Culture Investigations.

THE Electro-Culture Committee recently presented to the Minister of Agriculture its Seventh Interim Report, dealing with its work during 1924.* The work carried out by the Committee since 1918 has shown that under field experimental conditions an increased yield of 20 per cent. on the average may be expected when certain spring-sown cereals are subjected to high-tension electrical discharge, also that under both field and pot experiments electrification has accelerated repro-

* Copies of this Report can be obtained from the Secretary of the Committee, Mr J. H. Tabor, Ministry of Agriculture, 10, Whitehall Place, London, S.W.1.

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ductive growth much more markedly than vegetative growth. The results obtained in 1922 from pot-culture experiments at Rothamsted Experimental Station were so striking that the Committee decided to discontinue temporarily the field work and to concentrate for a time on pot-culture, small plot and laboratory work with the object of ascertaining the most suitable periods and the most suitable hours of the day for the discharge. The results of the pot-culture and small plot experiments in 1923 confirmed the results of the pot-culture experiments of 1922, viz., that electrification of spring-sown cereals for one month may be more effective than electrification for the full time (June to August).

The programme of work for 1924 was confined to pot-culture and small plot experiments on the lines of those conducted in 1923, with the addition of investigations dealing with the effect of the discharge over smaller periods than one month, and the effect of varying the strength of the current, since no knowledge was available of the lower strengths of current that are effective.

At Rothamsted Experimental Station pot-culture experiments were conducted to test various durations and strengths of current. Goldthorpe Barley "pure line" was used, as in previous years. Sets of pots were subjected to moderate current for six hours daily during the first month, the second month, the third month, for "full time" (June to August) and for two weeks in the second month respectively, and one set to weak current for the full time. All the six sets of cultures showed increases of grain yield over that of the controls, though in none was the increase larger than 21 per cent. There was not much to choose between the yield of plants subjected to the discharge for the first month and for "full time," and taking the size of the probable errors into account, it is doubtful if there is any significant difference between the treatment for the three single months and for the "full time." The results confirmed those of 1922 and 1923 in showing that one month's electrification is as effective as a "full time" one, but it does not decide the question as to whether the first, second or third month is the most favourable, though the evidence appears to favour the first or second month.

It is very noticeable that in the electrified plants the increase in grain yield is relatively higher than that of total yield (straw plus grain). A relative decrease in total yield may even be associated with an increase in grain yield.

To test the effectiveness of the normal air-earth current, a small area at Rothamsted, as in the past three years, was surrounded by a " cage " (consisting of parallel " earthed " wires about 6 centimetres apart) in which plants in pot-culture grew under conditions in which they were to a large extent excluded from the influence of the air-earth current. In 1924 a second cage with additional potential was also employed. For the first time in four years the " caged " plant gave an increase over the " uncaged " control, but this increase was not significant. The effect of the small artificial atmosphere potential was positive but not by itself significant.

Small plot experiments were conducted at Rothamsted and Lincluden (Dumfries). In consequence of the damage by pests at the former station the results were of little value. At Lincluden small plots of oats were subjected to electrification for the first month only, the second month only, the third month only and for the " full time " (June to August). In agreement with last year's results treatment for a single month was as effective as treatment for " full time." As was the case in 1923 the first month was more effective than the second or third. The plot receiving current for the first month only gave an increase over its relative control of 1 per cent. total yield (straw plus grain) and of 51.6 per cent. grain yield, the second month plot gave a decrease of 4.1 per cent. total yield and an increase of 10.9 per cent. grain yield, the third month plot a decrease of 7.2 per cent. total yield and an increase of 33.2 per cent. grain yield, while the corresponding figures for the " full time " plot were + 6.0 per cent. and + 25.7 per cent. The increase in grain yield is substantial, especially in the case of the first month's electrification.

The experiments of the present year are again being confined to small scale work to deal with the following four questions :—

(1) Whether the 1st or 2nd month's electrification is more effective.
(2) Whether the 1st and 2nd or 2nd and 3rd month's electrification is more effective than electrification for a single month or for the whole season.
(3) The daily duration of discharge.
(4) The intensity of discharge.

Laboratory studies on the effect on growth of an ionization current in air artificially ionized by the use of a radio-active substance are being continued during 1925 at the Imperial College of Science and Technology, while, in addition, the plant is being studied to ascertain at what stage in its growth the current can most usefully be applied.

Fruit and Vegetable Marketing.

AN account of the activities of the Gloucestershire Fruit and Vegetable Co-operative Society, Ltd., was given in this *Journal* in April, 1924, page 68. The Society has recently published a pamphlet entitled "Sound Marketing," containing much good advice, from which the following notes have been summarised.

The pamphlet points out the importance of growers realising the part necessarily taken by others in their industry. The idea should be ruled out that one individual can only profit by the loss of another. Those concerned in the fruit and vegetable industry are the grower, the wholesale buyer, the retail seller and the consumer, and growers are urged to do nothing which will prevent the other branches from doing their best.

It is the grower's business to produce fruit and vegetables, and after his crops have reached maturity and have been gathered or harvested the main function of his business has ceased. After this, he must look for the real results of his labours to other hands. One thing, however, it is in his power to do, which forms the last link that binds him to the results of his labours, namely, to present his produce in the form that will be most acceptable to the wholesale buyer, the retail seller and the consumer. No market can be really styled a growers' market, they are all buyers' markets, and in them the buyer's point of view will ultimately prevail.

Confidence is the basis of all successful trading, and confidence is not earned in a day. Growers will try a market by sending a single consignment, with perhaps disappointing results. There will always be fluctuations of price, and the proper way to test a market is to patronise it for a season and thus get the confidence of the buyers, who will look out for a grower's produce on each succeeding market day. The grower who tries to follow the luck of two or three different markets never gets anywhere in the end, whereas he might be engaged in building up a solid reputation in one market.

It is quite natural that growers should desire to sell their produce in the best market, but it should also be remembered that a co-operative market, established largely by growers, belongs to them, and it is in their interest to support it and make it the best market in the district.

Packing, Grading and Guarantee.—Grading is incomplete unless some identifiable guarantee goes with the produce. A ticket saying: "This fruit was grown by John Smith," is

useless. There are thousands of John Smiths in the country, and how is the retailer, whom the guarantee mostly concerns, to know which is which? The Cheltenham market has introduced a scheme whereby every grower can have a number which cannot be duplicated and which is placed on every package of produce he sells. If he does not place a number label on each package, such package has in reality no guarantee, for the wholesaler will probably split up his purchase upon resale to his customers, who will therefore not be able to demand the same produce again, and the value of the guarantee is lost.

The two standard grades for apples and pears are as follows :—

First Grade.—Good, large (for the variety), clean, sound and shapely fruit.

Second Grade.—Fruit of both large and medium size, but slightly inferior to first grade as regards cleanness, soundness and shapeliness; as well as medium size fruit of first grade description.

The reason for the adoption of these gradings is that some buyers require a really all-round first-grade fruit while others do a second-grade trade, and these are the gradings which experience indicates as those most sought after by the buyers. It will be noticed that first grade corresponds with the grading of imported fruit, and if home-grown fruit is to compete with overseas fruit, quality must compete with quality, and incidentally, weight with weight.

"We wish to impress upon growers the value of careful packing. The aim should be to present the fruit to the buyers in as near a state of perfection as possible: there should be uniformity in size and colour, neatness and general good finish. Fruit of specially high quality will pay for any extra care and time spent in putting it up in an attractive manner. All containers should be lined with paper (white for preference) so as to overlap and cover the top of the fruit."

"In marketing soft fruits, over-ripeness is a thing to be avoided. It should be remembered that a considerable period may sometimes elapse before the fruit reaches the consumer. Pears especially should be on the firm side. Ripe fruit should not be put into large containers. Vegetables, as well as fruits, pay for care taken in packing. Much of the cauliflower and broccoli that comes into our markets is trimmed too closely and buyers complain of damage sustained in transit. A simple way to pack cabbages and greens in nets is to place the net in a pot basket so that the edges and tying cord hang over the rim of the pot basket all round. Fill the package well up

and over the top, pressing well into the bottom corners. Lace tightly, and the finished pack will turn out of the mould almost a perfect cube."

"In the days of the wicker empty, it was often customary to pack produce direct into the empty in the market-garden or the orchard. But it is clear that the non-returnable cannot be so used. Fruit and vegetables should be gathered in receptacles kept specially for this purpose and packed into the non-returnable under cover to ensure the packages leaving the grower in a clean and dry state."

"All packages which are provided with covers should arrive in the market closed, and after stacking the produce on the floor of the market, one package of each class should be left open for the buyer's inspection. This will give the buyer that confidence which will lead him to trust to the honesty of the grower to pack fairly throughout."

Containers.—The vexed question of returnable or non-returnable package does not exist in this Society's markets, for the returnable package has been eliminated by them, and a non-returnable container is provided for every form of produce. It is a matter of considerable interest that the Society has met with so much success in promoting the use of non-returnables.

Standardised Weights.—"Another valuable advantage which we hold out to buyers is standardised weights and packages, and it is possible to buy in packages ranging from 12 to 48 lb. contents with covers, thus eliminating pilferage in the market as well as in transit. This brings us to our latest reform—the introduction of a container with lid to hold 40 lb. net weight of apples, and 48 lb. net weight of hard pears and green plums. Up to the year 1924 the standard container for apples was a package to hold 56 lb. net weight and weighing 64 lb. gross. This weight is too heavy for careful handling, and the new 40 lb. package for apples has become so popular with our leading growers that we already look upon the 56 lb. container as a thing of the past."

Farm Workers' Minimum Wages.

A MEETING of the Agricultural Wages Board was held on 21st July at 7, Whitehall Place, S.W.1, Mr. J. Willmot acting as Chairman in the absence of Lord Kenyon.

The Board considered a notification from the Hertfordshire Agricultural Wages Committee of a resolution fixing special minimum rates of wages for the corn harvest, and proceeded to make the neces-

sary Order carrying out the Committee's decision. The Order operates as from Monday, 27th July, and provides a special hourly rate of wages for all employment on the corn harvest in 1925, the rate in the case of male workers aged 21 and over being 10½d. per hour, and in that of female workers aged 21 and over, 7½d. per hour, less rates being fixed for younger workers.

Copies of the Order in full can be obtained on application to the Secretary of the Agricultural Wages Board.

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Farm Wages in Scotland.

THE Board of Agriculture for Scotland has now published particulars of the average wages paid to agricultural workers in every county of Scotland at Whitsuntide, 1925; for the purpose of the summary the country is divided into five divisions.

As compared with the similar statement issued in respect of Martinmas, 1924, it is observed that the wages of married men have fallen generally, the decrease being more marked in the northern part of the country than in the south. Thus, with certain exceptions, married ploughmen, cattlemen and shepherds have suffered decreases of from 1s. 2d. to 3s. 3d. per week in the N. and N.W. district (except in Harris, where wages have risen considerably); from 8d. to 3s. 11d per week in the N.E. district; and from 8d. to 4s. 10d. per week in the E.C. district. On the other hand, in the S.E., W. and S.W. districts increases ranging up to 3s. 6d. and 4s. 7d. respectively were received in some counties, although decreases of as much as 3s. 3d. and 1s. 8d. occurred in other counties.

Single ploughmen, on the contrary, generally received increases of wages, which ranged up to 7s. 8d. in the W. and S.W. district. In only one district—East Central—were any considerable decreases recorded, these amounting to as much as 9s. 5d. per week in one county.

The average wages which were being paid to married ploughmen at the time the return was compiled, were 33s. 11d. per week in the N. and N.W. division; 35s. 5d. in the N.E. division; 40s. 4d. in the E.C. division; 41s. 5d. in the S.E. division; and 40s. 3d. in the W. and S.W. division. The wages in the corresponding divisions in the case of single ploughmen were 31s., 36s. 5d., 37s. 5d., 35s. 10d. and 32s. 10d. per week respectively.

Number and Declared Value of Animals Living, for Breeding, Exported from Great Britain and Northern Ireland in the three months ended June, 1925, compared with the corresponding period in 1924.

(*From Returns supplied by H.M. Customs and Excise.*)

Country to which Exported	April to June, 1925		April to June, 1924	
	Number	Declared Value	Number	Declared Value
CATTLE		£		£
Argentina	210	48,000	189	28,400
Belgium	15	155	0	0
Columbia	5	501	0	0
Denmark	12	380	0	0
Germany	16	550	5	450
Japan	3	640	3	240
Uruguay	36	5,310	64	7,378
Irish Free State	1,999	25,622	2,924	34,575
Kenya Colony	9	455	3	200
Union of South Africa ...	40	3,192	0	0
Other Countries	14	1,370	10	706
Total of Cattle	2,359	86,175	3,198	71,949
SHEEP AND LAMBS				
Argentina	58	645	0	0
France	8	80	0	0
Germany	12	390	0	0
Japan	0	0	23	230
Morocco	0	0	6	101
Sweden	30	690	0	0
Irish Free State	328	750	64	378
Union of South Africa ...	15	264	0	0
Other Countries	3	62	9	159
Total of Sheep and Lambs	454	2,881	102	868
SWINE				
Argentina	5	92	11	540
Czecho-Slovakia	6	120	27	360
France	6	120	14	444
Germany	44	1,090	4	144
Italy	17	439	11	157
Japan	7	306	19	570
Netherlands	14	471	11	268
Ceylon	6	60	0	0
Irish Free State	118	583	129	241
Union of South Africa ...	59	1,254	0	0
Other Countries	15	228	5	92
Total of Swine	297	4,762	231	2,816

Scholarships for Agricultural Workers.

THE Ministry announces the following awards under the scheme of scholarships and maintenance grants for the sons and daughters of agricultural workmen and others:—

Class I (for three or four years at University Departments of Agriculture):—Frederick C. Bawden (Okehampton, Devon), Hubert R. Catchpole (Whitlingham, Norfolk), Robert F. Edwards (Castle Acre, Norfolk), Martha J. Graham (Brampton, Cumberland), William E. Gelling (Crosby, Isle of Man), Frederick W. Munnings (Sleaford, Lincolnshire), Audrey M. Polgreen (St. Germans, Cornwall), Edwin R. Wallace (Keswick, Cumberland), Kathleen Woolnough (Rayleigh, Essex).

Class II (for two years at an Agricultural College):—Charles E. Bland (Arundel, West Sussex), Charles V. Carter (Wellington, Salop), Stanley A. Child (Tawstock, Devon), John A. Evans (Carno, Montgomeryshire), Hilda M. Hatchwell (Newton Abbot, Devon), Norman P. Jones (Bethel, Carnarvon), Walter R. Penman (Ryton-on-Tyne, Durham), Mary A. Steel (Billingboro', Lincolnshire), Raymond Tamblyn (Scorrier, Cornwall), George Wells (Saxtead, Suffolk).

Class III.—111 scholarships have been awarded for short courses at Farm Institutes in agriculture, dairying, horticulture and poultry-keeping.

The number of applications for scholarships received was 493.

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International Conference of Agricultural Associations.

IN connection with the Swiss Agricultural Exhibition, an International Conference of Agricultural Associations will be held at Berne on 22nd and 23rd September next. The conference, to which the agricultural organisations of all countries are invited, is held for the purpose of examining the question of the constitution of an international organisation for the purpose of defending the common interests of agriculturists in international questions.

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AGRICULTURAL RETURNS OF ENGLAND AND WALES, 1925.

ACREAGE UNDER CROPS AND GRASS AND NUMBERS OF LIVE STOCK ON HOLDINGS ABOVE ONE ACRE IN EXTENT IN ENGLAND AND WALES AS RETURNED BY OCCUPIERS ON 4TH JUNE, 1925.

(The figures for 1925 are subject to revision.)

CROPS AND GRASS:

DISTRIBUTION.	1925.	1924.	INCREASE.		DECREASE.	
	Acres.	*Acres.*	*Acres.*	*Per Cent.*	*Acres.*	*Per Cent.*
TOTAL ACREAGE under all CROPS and [illegible]	25,755,000	25,877,000	—	—	122,000	0·5
ROUGH GRAZINGS	5.028,000	4,946,000	82,000	1·7	—	—
ARABLE LAND	10 680,000	10,929,000	—	—	249,000	2·3
PERMANENT GRASS { For Hay ..	4,312.000	4,501,000	—	—	189,000	4·2
PERMANENT GRASS { Not for Hay ..	10.763.000	10,447,000	316.000	3·0	—	..
PERMANENT GRASS { TOTAL ..	15 075.000	14,948,000	127,000	0·8	—	—
Wheat	1,499,000	1,545,000	—	.	46,000	3·0
Barley	1.319,000	1,314,000	5,000	04	—	—
Oats	1.867.000	2,038,000	—	—	171,000	8·4
Mixed Corn	124.400	134,500	—	—	10,100	7·5
Rye	50 300	58,600	—	—	8,300	14·2
Beans	190 890	241,700	—	.	50,900	21.1
Peas	131.000	171.200	—		40,200	23 5
Potatoes	493.200	452,200	41,000	9 1	—	—
Turnips and Swedes	806 400	832,500	—	—	26,100	3·1
Mangold	359 000	389,700	—	—	30,700	7·9
Cabbage, Savoys and Kale	73 000	80.200		—	7,200	9·0
Kohl-rabi	10.800	14,500	—	—	3,700	25·5
Rape	66 000	68,300	—	.	2,300	3·4
Vetches or Tares	88.400	112,300	—	—	23,900	21.3
Lucerne	54.000	64,600	—	—	10,600	16·4
Mustard for Seed	22.900	36,200	—	—	13,300	36·7
Brussels Sprouts	20.700	20,500	200	1·0	—	—
Cauliflower or Broccoli	11.700	12,400	—	—	700	5 6
Carrots	8.200	10,700	—	—	2,500	23·4
Onions	2.200	2,600	—	—	400	15·4
Celery	4.800	5,900	—	—	1,100	18·6
Rhubarb	6.200	6,300	—	—	100	1·6
Sugar Beet	54.700	22,400	32,300	144·2	—	—
Linseed	3 700	5,200	--	—	1,500	28·8
Hops	26.200	25,900	300	1·2	—	..
Small Fruit	68.400	73,500	—	—	5.100	6·9
Orchards	238 000	239,500	-	—	1.500	0·6
CLOVER and ROTATION GRASSES { For Hay ..	1.722.000	1,752,000	—	..	30,000	1·7
CLOVER and ROTATION GRASSES { Not for Hay	852.000	796,000	56,000	7·0	--	—
CLOVER and ROTATION GRASSES { TOTAL ..	2 574 000	2,548,000	26,000	1·0	--	—
BARE FALLOW	462 800	355,600	107,.0	30·1	-	—

Mountain Heath, Moor, Down and other rough land used for grazing.

The total area returned as under crops and permanent grass in England and Wales this year is 25,755,000 acres, or 122,000 acres less than in 1924. The area returned as rough grazings is 5,028,000 acres, an increase of 82,000 acres, so that the total area of land coming within the scope of the returns is 40,000 acres less than last year.

The area of arable land is 10,680,000 acres, a decline of 249,000 acres as compared with last year. This year's area is 318,000 acres, or about 3 per cent., less than in 1914. Practically every county shares in this year's decline.

Cereals.—In spite of unfavourable weather for sowing last autumn the acreage under wheat is only 46,000 acres less than in 1924. The

total of 1,499,000 acres is, however, the lowest since 1904. Some counties, including Norfolk, Lincoln and the Isle of Ely, have larger acreages than last year. On the other hand, reductions exceeding 10 per cent. are recorded in Bedford, Worcester, Hereford, the North Riding and a few other counties. Essex will harvest nearly 10,000 acres less than last year. There is little change in the area of barley, and the total of 1,319,000 acres is 5,000 acres greater than last year. The north-eastern counties have increased areas, but in other districts reductions are fairly general. Considerably less land is under oats this year, only 1,867,000 acres being occupied by this crop. This represents a decrease of 171,000 acres on the year and is the lowest acreage since 1888. Every county shared in the decrease, and in every division of England except the northern and north-western the reductions are approximately 10 per cent.

Forecasts of the yields per acre of corn crops, based on the condition of the crops on 1st August, suggest that the total production of wheat, barley and oats this year will be approximately as shown in the following table. It must be borne in mind that the forecasts of the yields were made when the great bulk of the crops were still uncut and are consequently subject to revision.

	Forecast, 1925. Cwts.	Production, 1924. Cwts.
Wheat	25,715,000	27,260,000
Barley	18,525,000	20,280,000
Oats	25,076,000	29,980,000

Beans and Peas.—The acreages of both beans and peas are smaller than last year by over 20 per cent. Beans cover 190,800 acres, the smallest area ever recorded, and peas 131,000 acres, the smallest area since 1917.

Potatoes.—For two seasons potatoes have sold at high prices and this probably explains the much increased plantings this year. The acreage on agricultural holdings is 493,000 acres, or 41,000 acres more than in 1924 and 58,000 acres above the pre-war average. All the chief potato-growing counties show increases, especially those in the east of the country.

Roots.—The area returned as sown or intended to be sown with turnips or swedes is 26,000 acres less than in 1924, and the total of 806,400 acres is the smallest ever recorded. The mangold area also shows a decline as compared with last year, only 359,000 acres being under this crop, a decrease of 30,700 acres. Only one county, Lincoln (Holland), has more land under mangolds than in 1924.

Sugar beet again shows a notable increase, 54,700 acres being under this crop as compared with 22,400 acres last year. The bulk of this crop is still in the east, but west midland and some south-western counties are growing appreciable acreages this year.

Other Crops.—All the minor fodder crops are being grown on reduced acreages, especially kohl-rabi which shows a decrease of 25 per cent., vetches which are reduced by 21 per cent. and lucerne by 16 per cent. The area of mustard grown for seed, 22,900 acres, is less than two-thirds that of 1924, but is greater than in 1921 and 1922. There is practically no change in the area of hops.

Vegetables.—Brussels sprouts are the only vegetable crop returned as occupying a larger area than last year and the increase is small. Carrots which were very cheap last winter record a fall of 2,500 acres.

Onions occupy an exceptionally small acreage. Celery which had been increasing in favour for some years has received a sharp set-back.

Fruit.—The acreage of orchards is much the same as in 1924. There is some increase in the south-eastern counties and a reduction in the west. Small fruit on the other hand shows a decline. More currants and gooseberries are returned but less strawberries and raspberries.

Clover and Rotation Grasses and Meadow Hay.—There is this year a slight increase in the area of clover and rotation grasses, the total being 2,574,000 acres against 2,548,000 acres in 1924. The acreage mown, however, has declined by 30,000 acres, but most of the eastern counties show increases. Less permanent grass also has been mown this year, the acreage kept for hay being 4,312,000 acres, a reduction of 189,000 acres, decreases being general throughout the country.

Fallow.—With heavy land working very unkindly after the wet winter, it is not surprising to find a large increase in the area of bare fallow. The total acreage, 462,800 acres, is 107,000 acres greater than in 1924, but is smaller than in the three years following the war.

LIVE STOCK.

CATTLE.

	1925.	1924.	Increase.	
	No.	No.	No.	Per Cent.
Cows and Heifers in Milk	2,035,100	2,014,200	20,900	1·0
Cows in Calf, but not in Milk ...	299,600	281,500	18,100	6·4
Heifers in Calf	378,500	367,400	11,100	5·0
Other Cattle :—Two years and above	1,061,000	986,800	74,200	7·5
" " One year and under two	1,177,500	1,084,400	93,100	8·6
" " Under one year ...	1,211,600	1,160,000	51,600	4·4
Total of Cattle	6,163,300	5,894,300	269,000	4·6

The number of cattle again shows an increase, and the addition this year is greater than in any recent year. The total of 6,163,000 is 269,000 larger than in 1924 and 646,000 greater than in 1921. The average in the ten years immediately preceding the war was 5,809,000. Practically every county has more cattle than last year. Cows and heifers in milk or in calf number 2,713,000, or 50,000 more than last year, which already was a record number. Calvers show relatively a larger increase than cows in milk. Cheshire has now more dairy cattle than in 1923. Other cattle of all ages are in greater numbers than last year, and more calves are being reared than in any year since the war. The number of cattle under one year old is 1,211,600, or 46,600 more than the pre-war average.

SHEEP.

	1925.	1924.	Increase.	
	No.	No.	No.	Per Cent.
Ewes kept for Breeding	6,392,500	5.993,600	398,900	6·7
Other Sheep :—One year and above...	2,882.200	2,557,800	324,400	12·7
" " Under one year ...	6,699,700	6,291.800	407,900	6·5
Total of Sheep	15,974,400	14,843,200	1.131,200	7·6

For the third year in succession the flocks of the country have been increased, and the total number of sheep and lambs, 15,974,000, is 1,131,000 greater than in 1924. The flocks are now within measurable distance of the pre-war numbers; a further increase similar to that of this year would restore the flocks practically to the 1914 level. Increases in the flocks were general throughout the country. The number of breeding ewes is 6,392,000, an increase of practically 400,000, the total being now only 300,000 less than in 1913. The number of sheep, other than breeding ewes, above one year old is about 12½ per cent. greater than in 1924, and there are increased numbers in practically every county.

PIGS.

	1925.	1924.	Decrease.	
	No.	No.	No.	Per Cent.
Sows kept for Breeding	316,300	449,000	132,700	29·6
Other Pigs	2,326,700	2,779,300	452,600	16·3
Total of Pigs	2,643,000	3,228,300	585,300	18·1

The exceptionally large number of pigs recorded last year has not been maintained, but in spite of the reduction of 585,000, or 18 per cent., the number is still large as compared with previous years. The total number returned as on agricultural holdings is 2,643,000, or 379,000 more than the average of the ten years 1915-24. Breeding sows show a relatively sharper reduction than other pigs, and the total of 316,300 is only 2,000 above the ten years' average. Every county has fewer sows than last year, but Cheshire shows an increase in its total of pigs.

HORSES.

	1925.	1924.	Decrease.	
	No.	No.	No.	Per Cent.
Horses used for Agricultural purposes (including Mares for Breeding).	773,100	782,500	9,400	1·2
Unbroken Horses (including Stallions) One year & above	149,100	181,400	32,300	17·8
Unbroken Horses (including Stallions) Under one year	44,800	54,800	10,000	18·2
Other Horses	197,100	213,500	16,400	7·7
Total of Horses	1,164,100	1,232.200	68,100	5·5

The number of horses on agricultural holdings shows a further decline this year. The reduction is mainly in unbroken horses, and horses not used for agricultural purposes. Horses used for agricultural purposes number 773,000, or 9,400 less than in 1924, but only 18,000 less than in 1914. Unbroken horses above one year old number 149,000, or 32,000 less than last year. The number of foals bred this season again shows a very sharp decline and the total is little more than 40 per cent. of the number of 1914. The amount of horse-breeding now taking place seems quite insufficient to maintain the working horses on farms on their present level.

ACREAGE OF HOPS.

PRELIMINARY STATEMENT compiled from the Returns collected on the 4th June, 1925, showing the ACREAGE under HOPS in each COUNTY of ENGLAND in which Hops were grown, with a COMPARATIVE STATEMENT for the Years 1924 and 1923.

COUNTIES, &c.		1925.	1924.	1923.
		Acres.	Acres.	Acres.
KENT	East	3,690	3,660	3,540
	Mid	5,420	5,410	5,200
	Weald	7,150	6,900	6,720
	Total, Kent	16,260	15,970	15,460
HANTS		1,010	1,010	1,020
HEREFORD		4,150	4,100	3,890
SURREY		180	220	210
SUSSEX		2,420	2,390	2,260
WORCESTER		2,060	2,080	1,950
OTHER COUNTIES		110	100	100
	Total	26 220	25,900	24,890

Foot-and-Mouth Disease.—*Yorkshire* (East Riding) outbreak.—No further cases of the disease followed that confirmed at Ottingham on 3rd July, and the restrictions imposed on the movement of animals in East Yorkshire were consequently withdrawn on 1st August.

Hampshire.—Two cases of foot-and-mouth disease occurred at Fawley, near Southampton, on 1st August. The infected animals, and those in contact with them—totalling 54 cattle, 37 pigs and 177 sheep—were slaughtered, and restrictions were imposed immediately on the movement of animals within a radius of about 15 miles from Fawley.

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Vol. I.—The Farm: Its Nature and Treatment. (207 pp.) 17s. 6d. net.
,, II.—Croppings, Pastures, and Weeds. (295 pp.) 21s. net.
,, III.—Live Stock, Labour, and Marketing. (240 pp.) 17s. 6d. net.
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New York Agricultural Experiment Station.—Bulletin 516 :—Twenty-five Years of Fertilisers in a New York Apple Orchard. (28 pp.) Geneva, 1924. [63.41-16.]

Plant Diseases.

Barford & Perkins, Ltd.—Eelworm (*Tylenchus devastatrix*) in Narcissus. (24 pp.) Peterborough, 1925. [63.27.]

Nebraska Agricultural Experiment Station.—Research Bulletin 29 :—Further Studies on the Effect of Environment on Potato Degeneration Diseases. (32 pp. + 7 pl.) Lincoln, 1925. [63.23.]

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Ernle, Lord.—The Land and its People; Chapters on Rural Life and History. (257 pp.) London: Hutchinson, 1925, 10s. 6d. [338.1(42).]

Geary, F.—Land Tenure and Unemployment. (256 pp.) London: Allen & Unwin, 1925, 10s. 6d. net. [333.5(42); 331(42).]

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NOTES FOR THE MONTH.

Co-operative Marketing in the United States.

THE fourth number* of the Economic Series of reports, which are now in course of issue by the Ministry, is of particular, though indirect, interest to this country.

Nearly all the food exporting countries in the world, and many of the food importing countries, have well-developed co-operative marketing organisations. Of the remainder it is probable that Great Britain is one of the most backward. It is unlikely, however, that this country can lag behind for long, and therefore in the development of a marketing organisation the whole experience of the world should be drawn upon.

The co-operative marketing organisations of the U.S.A. have incorporated many of the most modern and some of the most successful ideas and methods, and, accordingly, a study of these methods must be of the greatest value to those countries in which such an organisation still remains to be built up. Therefore, as Mr. Forrester points out in his foreword, " All investigations of the business situation of individual associations over a series of years and the large mass of small scale co-operation have been necessarily omitted. . . . The material has been collected, arranged and analysed wholly with a view to casting into relief the constructive ideas which are being worked out in the organisation of the large scale co-operative. . . . "

Co-operative marketing in the U.S.A. has, of course, historical and economic foundations, and these, while they could not wholly be ignored, have been dealt with as briefly as possible. The major part of this survey is concerned with descriptions of certain large scale co-operative marketing associations, and these descriptions are designed to point out and emphasise how a certain group of ideas has in each case been adapted to suit peculiar needs of the association in question. In the concluding chapters the threads are drawn together by means of analytical discussions of certain aspects, such as the

* Report on Large Scale Co-operative Marketing in the United States of America, by R. B. Forrester (H.M. Stationery Office, 1s. 6d., post free 1s. 9d.).

(63278) P.6./R.4. 8,000. 10/25 . M. & S. A

commercial, the financial and the legal. Finally, the Report concludes with the following brief but significant paragraph with which it might also have opened:—" Large scale co-operative marketing is a new invention in producers' organisation in agriculture. It brings the notions and outlook of big business into the marketing of farm products. It is for the British farmer to consider whether, and in what way, its salient features can be applied to British conditions."

* * * * * *

Co-operative Purchase of Agricultural Requisites.

SLOW though this country has been to adopt the co-operative methods of marketing produce which have made such rapid headway in many younger, and in some equally old, countries, England and Wales were among the first in the field in the co-operative purchase of agricultural requisites, and can show progress during the last thirty years that will bear comparison with most rival organisations.

The development in this country has been, however, on peculiarly national lines, as will be realised by those who read the newly issued " Report on Co-operative Purchase of Agricultural Requisites in England and Wales."* While still faithful to the traditions of the Rochdale consumers' movement, the agricultural purchase movement has not been so receptive of new ideas, and particularly of " big business " ideas, as has the consumers' movement from which it received its initial impetus. That the movement is in a sound and healthy condition, nevertheless, the Report contains ample evidence.

The Report is a companion volume to that on " Co-operative Marketing of Agricultural Produce " of which mention was made in the May issue of this *Journal*, p. 97, and it is built round a very similar framework. After an historical account of the movement, from its origin in the seventies of last century up to 1923, and a brief explanation of the method of classification employed, the Report describes representative societies, as examples of varying types of organisation, and follows up the descriptions, in the case of each type-group, by a critical analysis of various factors, such as finance or management, to which in the past the success or failure of societies may be attributed and on which their future prosperity is equally dependant.

* " Co-operative Purchase of Agricultural Requisites in England and Wales," H.M. Stationery Office, 1s. 6d.

The movement, however, presents certain problems which have never yet been squarely faced. One of these is "federation," a word which must, in the minds of many, be associated with the ill-fated Agricultural Wholesale Society. Another is the inter-relationship of the consumers' and the producers' co-operative movements. To each of these a separate chapter is devoted. In the final chapter certain causes of weakness in the movement are referred to in more general terms, and there is raised at least one idea new to this country, though not to others, namely, the desirability of the existence in some form or other of contractual relations between a member and his society.

It is not to be expected that this Report will in its entirety meet with the approval of all those interested in agricultural co-operation, but it is certain that it will arouse their interest.

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Report of Agricultural Council on Agricultural Policy.

THE Report of the Council of Agriculture for England on Agricultural Policy, which was agreed at their meeting of 6th August last, reported in the September issue of this *Journal*, p. 525, has now been published by H.M. Stationery Office, price 4d., net.

Many farmers and others interested may desire to acquaint themselves with the details of the Council's suggestion of a subsidy for production and employment, as well as their views upon the other items which they dealt with as the main points of a permanent policy for agriculture.

With regard to the subsidy proposal, the Council state that they understand that the Government is deeply impressed with the vital importance of the industry of agriculture in the national economy, and is of opinion that a fresh attempt should be made to arrive at an agreement as to the measures which are necessary to secure the objects which all parties in the country unite in desiring. The Report proceeds to state what those objects are, and reaches the conclusion that more food cannot be produced and the agricultural population maintained or increased unless there is an improvement, and if possible an extension, of the arable land of the country, which cannot be obtained under present circumstances unless arable cultivation is artificially assisted.

The Report suggests that such assistance, if the nation decides to give it for the object which it has in view, should take the form of a subsidy per acre upon the land which a farmer works

year by year in bare fallow or in fallow crops up to a maximum of one-fourth of his total arable area. The Council consider that this kind of subsidy offers a more certain return to the nation for its assistance than any other form of subsidy; that it is fairly general in its application to all kinds of arable farming; that it will keep the land in good heart and condition with a full complement of men, horses and machinery, ready to supply at any moment of emergency the full production of human food of which the land is capable; that it does not give an advantage to the farmer on the better land over the farmer on the poorer; that the liability of the State under it would be a definite and, within certain margins, a limited one, and that it would be comparatively easy of administration. The chief reason for the adoption of this form of subsidy is stated by the Council, however, to be that it would bring into special prominence year by year that important fundamental condition of high farming, which, under any other system of guarantee or subsidy, would be apt to be obscured, namely, the thorough cleaning and manuring of the land.

They suggest that the definition "bare fallow or in fallow crops" should embrace bare fallow and roots, or other crops grown for the purpose of cleaning and manuring the land so as to prepare it for a succeeding white straw crop. Claims for payment of the subsidy should, it is suggested, be sent in with the annual agricultural returns and duly paid after the County Agricultural Committee has certified the acreage of bare fallow or fallow crops on each holding, and that such crops are suitable for the purpose of cleaning and manuring the land; in any cases where the fallow land was not being adequately cultivated, the Committee would be empowered to withhold their certificate. The Council estimate that a subsidy of £2 per acre on fallow and fallow crop land up to one-quarter of the arable land of the country would not exceed 5 million pounds for England and Wales under present conditions.

In making their other suggestions to the Minister for a permanent policy for agriculture, the Council deal in Part II of their Report with (1) the better application of agricultural education and research to agriculture, in which they suggest that the Government should alter the curriculum in country schools to include a definite rural bias in the type of education given at them, and that a preference should be given in engaging teachers for country schools to those who have a knowledge of rural life; (2) the encouragement of small holdings, the institution of

cottage holdings and the improvement of rural housing, in which section they suggest that farm labourers should be supplied with a real ladder of progress to become farmers, and that to assist this object there should be an increased number of cottages with gardens, cottage holdings, small holdings and small farms, and, further, that special attention should be paid to reconstructing and improving old cottages which are below the modern standard of health and accommodation; (3) increased facilities for agricultural credit; (4) better marketing and transport of agricultural produce; (5) the steadying of agricultural prices; (6) the removal of more of the heavy taxation burdens on land; (7) the improvement of land drainage; and (8) the liming of land.

* * * * * *

The Planning of Poultry Houses.

THE first essential in poultry-keeping is the provision of adequate accommodation for the stock. It is vain to expect profitable egg production or vigorous birds unless this matter receives due consideration. Fowlhouses vary in form and structure according to the purpose for which they are intended, and the climatic conditions of the locality in which they are to be built. The general principles underlying their construction, however, remain the same in any ordinary circumstances, and apply equally to the small pen in a suburban garden and to the wider area at the command of the rural resident. Any design which provides proper lighting and ventilation, protection from draughts and damp, and sufficient space for the birds and for cleaning operations, may be regarded as satisfactory and efficient.

At the present time, when poultry-keepers are paying increased attention to the housing of their stock, the publication of an authoritative manual on the subject is particularly opportune. Miscellaneous Publication No. 47, "The Planning of Poultry Houses," just issued by the Ministry of Agriculture, 10, Whitehall Place, S.W.1, price 1s., post free, in addition to text illustrations, contains designs for a 14 ft. laying house, with a two-thirds span roof, in sections, capable of indefinite extension; a lean-to laying house of the same capacity; a Lancashire cabin, specially suitable for high and exposed situations; a double-breeding pen; a Sussex Night Ark for the rearing of young birds; a house suitable for "backyarders" with only a limited space at their disposal; also a "Philo" coop for the use of backyarders who cannot provide an outside run. The plans are accompanied by descriptive letterpress, and specifications and quantities of materials required in each case are included.

Report of Proceedings under the Allotments Acts, for 1924.

THIS Report* which the Ministry is required to make to Parliament under Section 59 of the Small Holdings and Allotments Act, 1908, has recently been issued. The Report reviews the position as revealed from the statistical returns received by the Ministry from Allotments Authorities in England and Wales, which show that the area of land held by these authorities for allotments has decreased by 493 acres during the year. In addition, a large quantity of land is let as allotments by private owners without the intervention of the local authority, and on the assumption that there has been a corresponding diminution during the year in the area of land so used, the number of allotments in the country at the end of 1924 is estimated at 1,170,000 covering an area of 168,500 acres, as compared with 1,190,000 on 170,000 acres at the end of 1923. The decline is attributed to the fact that land in the neighbourhood of towns which was utilised for allotments during the War, but which by reason of its value for development purposes could not reasonably be expected to be retained permanently for allotments, is being gradually withdrawn for other purposes, and in support of this conclusion, it is pointed out that the reduction is confined almost entirely to urban areas.

The difficulty of providing allotments in districts where development is active is also discussed, and it is pointed out that in such districts, as existing allotment land is given up with a view to its use for building and industrial purposes, it is practically inevitable that the requirements of the allotment holders must be met by the acquisition of land on the outskirts of the town or district, and outside the building zone, even though this may entail some inconvenience to the plotholders.

Other paragraphs of the Report deal with the action of the Ministry in 1924 in connection with the administration of the Allotments Acts, and the cost to the Exchequer to date of the allotments provided under the Cultivation of Lands Orders, commonly known as D.O.R.A. Allotments.

Appendices to the Report contain statistical information compiled from the Returns furnished to the Ministry by the various Allotments Authorities.

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* The Report is obtainable, price 9d, from H.M. Stationery Office, Adastral House, Kingsway, W.C.2, and provincial Branches, or through any Bookseller.

Examination of Wheat Samples for presence of Bunt.

INVESTIGATIONS recently carried out at the Official Seed Testing Station for England and Wales have revealed that many of the samples of seed wheats received at the Station are infected with bunt, in one season over 40 per cent. showing traces of the disease. The National Institute of Agricultural Botany understand that many seed merchants and farmers would like to be able to have samples of their seed wheats examined for bunt, and the Institute has therefore arranged for this service to be undertaken in future by the Official Seed Testing Station.

Samples sent for examination must be at least 4 oz. in weight, and each sample must be enclosed in a separate strong envelope and forwarded either separately or in a well made up parcel addressed to:—

The Chief Officer,
Official Seed Testing Station,
Huntingdon Road,
Cambridge.

The following particulars should be given on the outside of the packet or in a covering letter:—

(1) Full name and postal address (including county) of sender.
(2) Date when sent.
(3) Kind and variety of the seed.
(4) Sender's reference number or mark if several samples are sent.
(5) Whether the sample is to be tested for bunt only, or both bunt and germination.

Postages on letters or parcels must in all cases be prepaid. Addressed envelopes for the purpose of sending seeds to the station may be obtained on application to the Chief Officer, Official Seed Testing Station. The receipt of samples will *not* be acknowledged.

The fee for examination for presence of bunt is 2s. per sample, whether sent by a farmer or seedsman. If a germination test is also required the usual fee (see Form No. 728/C.S.) will be charged in addition. One sample will be enough for both tests. The appropriate fees must accompany the samples unless the sender has a deposit account with the Official Seed Testing Station. Cheques and postal orders should be made payable to the National Institute of Agricultural Botany and crossed " Westminster Bank Ltd."

Samples will be dealt with in strict rotation as received, and the report will simply state whether bunt has been found to be present or not.

* * * * * *

National Rat Week, 1925.

THE week commencing 2nd November next has been fixed by the Ministry as a National " Rat Week," when an intensive and co-ordinated effort for the destruction of rats will be made.

At this time of the year rats will be returning in numbers from the fields and open lands to their winter quarters in town premises, and it is therefore a favourable opportunity for dealing with them.

All local authorities responsible for the execution and enforcement of the Rats and Mice Destruction Act, 1919, which requires all occupiers of lands and premises to keep such lands and premises clear of rats and mice, are being urged, by means of a circular letter from the Ministry, to put in hand, without delay, special measures for the purpose of bringing the matter to the notice of the public, and for assisting in the actual destruction of rats.

Local authorities are, of course, free to take whatever steps they may think desirable, but among the suggestions put forward by the Ministry for consideration, are :—

(*a*) That the local authority's own refuse dumps, sewage farms, and sewers, should receive close attention;

(*b*) That publicity through the Press, cinema, and by advertisements and posters should be obtained;

(*c*) That in villages special committees might be formed to consider a plan of action suitable to local conditions;

(*d*) That rat clubs be formed in connection with which prizes might be offered for rats destroyed;

(*e*) That local troops of the Boy Scouts' Association should be asked to co-operate.

The Ministry has prepared a cinematograph film, and also several sets of lantern slides illustrative of the habits of, and the damage caused by rats, and explaining methods of destruction and repression. The Ministry has offered to loan these to any local authority who may be able to use them. Each local authority has been supplied with a schedule suitable for general publication of simple methods of preparing rat baits, traps, and other appliances.

It is hoped, therefore, that large numbers of rats will be destroyed as the result of this year's " Rat Week " campaign.

* * * * * *

The Seeds (Amendment) Act, 1925.

PROCEEDINGS for an offence against the Seeds Act, 1920, must normally be instituted within six months of the date of the alleged offence. It has, however, frequently been found in practice that it is impossible to ascertain whether a consignment of seed potatoes has been correctly described as regards variety (one of the particulars which the Seeds Act requires the seller to state in writing at the time of sale or delivery) until the crop is grown, which may often be more than six months after the date of the delivery of the seed. An amending Act—the Seeds (Amendment Act, 1925—has therefore been passed which permits proceedings for an offence under the Seeds Act, 1920, for making or causing to be made a false statement as to the class or variety of seed potatoes, being commenced at any time within 12 months of the date on which the alleged offence was committed. *The amending Act does not affect in any way sales of other kinds of seeds covered by the Seeds Act,* 1920.

* * * * * *

The Agricultural Index Number.

THE general level of the prices of agricultural produce during August was 56 per cent. above the level of the corresponding month in 1911-13 as compared with 51 per cent. above in July, the increase being chiefly due to barley which realised considerably higher prices, and to the fact that the reductions recorded for fat cattle and potatoes were relatively smaller than in pre-war years. In August, 1924, the index number was 59 per cent. above the basic years.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.	1925.
January ...	200	183	75	68	61	70
February ...	195	167	79	63	61	67
March ...	189	150	77	59	57	65
April ...	202	149	70	54	53	58
May ...	180	119	71	54	56	57
June ...	175	112	68	51	58	55
July ...	186	112	72	53	52	51
August ...	193	131	67	54	59	56
September	202	116	57	56	60	—
October ...	194	86	59	51	63	—
November	193	79	62	53	64	—
December	184	76	59	56	63	—

Wheat and oats were 2d. and 3d. per cwt. respectively cheaper than in July, although the index figure for wheat was unchanged at 47 per cent. above 1911-13, and that for oats advanced from 34 to 43 per cent. above the index of the base years, as the fall in price was relatively much smaller than in pre-war years. Barley averaged 12s. 3d. per cwt. and was 2s. 2d. per cwt. dearer than in the previous month, the index number advancing 28 points. As compared with August, 1924, wheat and barley were each 1s. per cwt. cheaper, but oats were 4d. per cwt. dearer.

Fat cattle declined slightly in value, but as the reduction was proportionately less than in 1911-13, the index number advanced 6 points. Fat sheep were slightly cheaper on the month at 1s. 0¾d. per lb., the percentage increase falling from 79 to 76 above the base years, but both bacon and pork pigs became dearer, the index figures recording increases of 1 and 4 points respectively. Fat cattle sold at about the same price as a year ago, but fat sheep were much cheaper, while pigs were approximately 15 per cent. dearer.

Dairy cows realised rather more money and, as the rise was proportionately the same as in the base years, the index number was unchanged. Store cattle, however, continued to decline in value, the index number falling 3 points on the month. Store sheep were also cheaper, but averaged 91 per cent. above pre-war cost, and were relatively the dearest of any class of store stock. Store pigs advanced in value in sympathy with the higher prices ruling in the fat pig market, the index figure rising from 53 to 57 per cent. above the level of 1911-13.

Milk shows an advance of 5 points owing to the higher prices paid for contract milk delivered to the Manchester area. Contract prices for milk delivered to London and Birmingham were again unchanged. Both butter and cheese sold at higher prices, but the index number for the former was unaltered, while cheese advanced from 70 to 78 per cent. above the cost in the base years. Eggs were scarce and again dearer, an increase of 3d. per dozen being recorded, the index number advancing to 67 per cent. above the corresponding month of 1911-13. All classes of dairy produce were dearer than in August, 1924, especially cheese, which was about 8 per cent. dearer.

The wholesale markets have been well supplied with potatoes, and prices have gradually declined throughout August, the average for the month being £6 14s. 6d. as com-

pared with £7 19s. per ton in July, but as the decrease was not in proportion to the fall in the base years, the index figure has advanced 24 points to 67 per cent. above pre-war cost. Owing to clover hay being fractionally dearer the index figure for hay records a slight increase, but on the whole hay sold at practically the same price as in 1911-13.

Apples were about half as dear again as in the base years, while plums were extremely dear, selling at about 130 per cent. above pre-war cost. Both cabbage and cauliflowers declined in value, the former being about 65 and the latter approximately 40 per cent. above the 1911-13 prices.

Index numbers of different commodities during recent months and in August, 1923 and 1924, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	1923.	1924.	1925.			
Commodity.	Aug.	Aug.	May.	June.	July.	Aug.
Wheat ...	29	59	59	62	47	47
Barley ...	9	75	36	38	34	62
Oats	30	38	36	38	34	43
Fat cattle ...	46	56	49	50	48	54
Fat sheep ...	76	100	100	93	79	76
Bacon pigs ...	44	33	60	54	51	52
Pork „ ...	57	35	60	53	52	56
Dairy cows ...	51	57	48	47	50	50
Store cattle ...	28	48	40	43	42	39
Store sheep ...	101	129	99	115	115	91
Store pigs ...	102	29	55	55	53	57
Eggs... ...	68	63	48	52	61	67
Poultry ...	61	66	55	61	75	58
Milk	67	58	55	55	57	62
Butter ...	48	67	54	57	73	73
Cheese ...	67	66	70	78	70	78
Potatoes ...	80	72	124	76	43	67
Hay	34	3	3	3	0	3

* * * * * *

STATE ASSISTANCE FOR WINTER LAND DRAINAGE WORKS.

REPORT UPON LAND DRAINAGE SCHEMES FOR THE RELIEF OF UNEMPLOYMENT, 1924-25.

FOR the fourth winter in succession the Ministry has been enabled by Parliament to provide State grants in aid of land drainage works, and, in a smaller measure in aid of water supply works, in agricultural areas.

As in the preceding three winters, grants were made to Drainage Authorities, and (through County Councils) to groups of landowners co-operating for this purpose.

In order that no time should be lost in the preparation of schemes for an early commencement in the autumn, a preliminary notice was circulated to all concerned on 16th May, 1924. This was followed on 28th June, 1924, by a circular letter setting out the terms and conditions of grants towards approved works to be completed between 1st October, 1924, and 31st May, 1925.

The conditions laid down were generally the same as for the previous seasons, but in order to encourage larger schemes of arterial drainage, the restriction on the proportion of materials expenditure was relaxed to facilitate the reasonable use of mechanical dredging plant and the provision of the necessary materials for river training works, etc., such as piling and groyning.

Up to 4th October, 1924, 100 schemes had been finally or provisionally approved at a total cost of £123,633. Owing, however, to the lateness of the harvest and consequent absorption of labour thereon, only 10 schemes were in operation by that date. About the same period wet weather again began to exercise a retarding influence on the development of schemes, and in a greater degree than in the preceding seasons. Whereas the average rainfall in England and Wales over the period September, 1923, to May, 1924, was 31.15 inches, the figure for the corresponding period for 1924-25 reached 34.02 inches.

Since the inauguration of these schemes in 1921 the weather has become increasingly wet, year by year, as is shown by the following table :—

AVERAGE RAINFALL.

September, 1921—May, 1922	=	24.81 inches.
„ 1922— „ 1923	=	27.19 „
„ 1923— „ 1924	=	31,15 „
„ 1924— „ 1925	=	34.02 „
Average for 35 years, September to May, 1881—1915	=	26.57 inches.

It will be readily understood, therefore, that the schemes could not develop early in the absence of the labour on harvesting operations, and that the subsequent abnormally wet weather greatly affected the whole programme.

Although 76 schemes had to be abandoned and a number were left incompleted, valuable results were again achieved, the 462 schemes which were put into operation having provided 643,553 man days employment and benefited 668,529 acres of land.

Approximately £245,000* was spent in execution of the various undertakings of Sea Defence, Drainage and Water Supply, towards which the State is contributing approximately £155,000.

Labour.—The altered conditions of agricultural employment have depleted the rural districts of casual labour, and in the absence of the local supply, labour for the schemes was, in a larger measure than before, recruited from small towns adjacent to agricultural areas.

Wages and Allowances.—The local rate of wages for unskilled agricultural workers as fixed by Agricultural Wages Committees under the Act of 1924, was paid in the majority of cases.

Transport was provided to bring distant workers to the schemes, or alternatively train, bus, cycling or walking allowances were paid to all men residing over two miles from their job.

Statistical Summary and Sketch Map.—The summary and sketch map on p. 591 give an analysis of the cases dealt with, their distribution throughout England and Wales, and shows the seven divisional areas into which the country was divided for the purposes of supervision by the Ministry.

Voluntary Schemes organised by County Agricultural Committees numbered 310, of which 234 were schemes of Land Drainage and Sea Defence executed at a total cost of £78,842, and 76 were Water Supply Schemes towards which grants totalling £11,462 were made.

These schemes, which were the more numerous of the two classes, were on the whole on a smaller scale than those promoted by Drainage Authorities.

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* This figure, which is only approximate, represents the anticipated total cost after all accounts have been examined.

It must not be implied, however, that they were for this reason of less importance. These works have often been executed in disjointed lengths along a water-course, and the outfall has not always been tackled first because of the difficulties in securing co-operation for the clearance of the whole stream in the first instance. Nevertheless, it has been possible to link up the small schemes of the several years in a manner undreamed of in 1921. The example set by the efficient cleansing of one section has inspired extensions. Much remains to be done to enlarge and improve upon this work, particularly on main streams and rivers, to ensure that the arterial drainage of the country is placed in a sound position.

County Authorities do not possess the requisite powers to enforce cleansing of watercourses, and it has been possible for landowners with sufficiently large holdings to obstruct and prevent the execution of desirable and necessary works.

There is the important point that the winter is not the best season for drainage operations, and some landowners would not co-operate in winter schemes for this reason.

In the face of adverse conditions much consistently good work has been accomplished, particularly in the counties of Wilts., Gloucester, Warwick and East Suffolk.

Drainage and Sea Defence Authorities were responsible for the execution of 152 schemes at a total cost of £154,414, of which amount £97,418 was spent on schemes of Land Drainage, and £56,996 on Sea Defence.

A number of large schemes for the improvement of main rivers and outfall channels were promoted in order to take advantage of the additional facilities offered for that purpose, but owing to the exceptionally wet season several of these schemes had perforce to be modified. Most of these schemes were located in the Eastern Counties, Sussex, and Somerset, where drainage is a vital necessity, but the whole country absorbed a fair share of the grants provided.

The severe gales of October, 1924, to January, 1925, caused considerable damage to the Sea Defences of Drainage Districts throughout the country, particularly on the South Coast, and much of the repair work was assisted by the Ministry's grants, as at Pett Level and on the Shoreham and Lancing frontage.

In several places river embankments gave way and inundated many acres of land, a particularly severe case being that of the River Aire, Yorkshire.

STATISTICAL SUMMARY AND DIVISIONAL AREAS.

No. 1 Hunts, Cambs, Beds, Norfolk and Suffolk
„ 2 Wales and Shropshire, Worcester, Stafford, Warwick, Hereford and Monmouth
„ 3 Northumberland, Durham, Cumberland, Westmorland, Yorks, Lancs and Cheshire
„ 4 Derby, Notts, Lincs, Leicester, Rutland and Northants
„ 5 Essex, Kent, Middlesex, East and West Sussex
„ 6 Wilts and Somerset
„ 7 Oxford, Berks, Gloucester, Bucks, Herts, Middlesex, Surrey, Hants, Dorset, Devon and Cornwall

Area No.	Numbers of Schemes: Drainage	Numbers of Schemes: Sea Defence	Numbers of Schemes: Water Supply	Carried out by: Drainage Boards	Carried out by: County Councils	Totals	Number of Man-days Worked	Approximate Expenditure: Drainage	Approximate Expenditure: Sea Defence	Approximate Expenditure: Grants in aid of Water Supply	Approximate Expenditure: TOTALS	Approximate Acreage benefited or protected from inundation
								£	£	£	£	
1	52			33	19	54	120,918	43,971			44,491	180,538
		2		1	1				520			
			—	—	—					—		
2	81			20	61	84	67,519	21,640			25,227	48,965
		2		2	—				3,150			
			1	—	1					437		
3	44			11	33	50	120,328	22,863			51,143	90,294
		5		5	—				26,878			
			1	—	1					1,402		
4	37			26	11	38	60,656	23,884			23,937	165,440
		—		—	—				—			
			1	—	1					53		
5	19			16	3	42	106,213	19,259			45,611	87,584
		22		18	4				26,302			
			1	—	1					50		
6	70			12	58	129	128,155	31,769			41,356	81,973
		3		3	—				2,210			
			56	—	56					7,377		
7	49			5	44	65	39,764	10,810			12,953	13,735
		—		—	—				—			
			16	—	16					2,143		
Totals	352	34	76	152	310	462	643,553	174,196	59,060	11,462	244,718	668,529

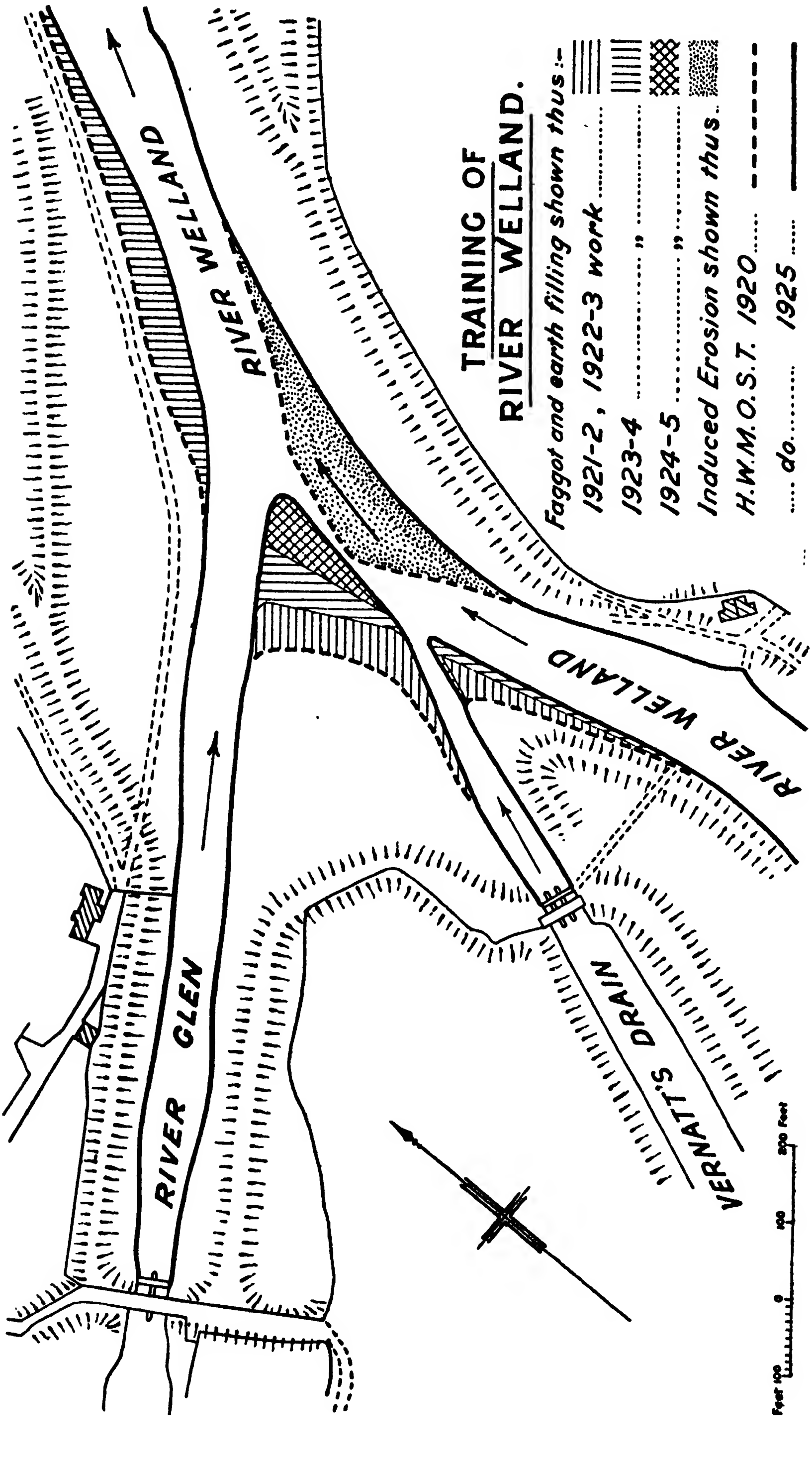

TRAINING OF
RIVER WELLAND.
Faggot and earth filling shown thus:-
1921-2, 1922-3 work
1923-4 ,,
1924-5 ,,
Induced Erosion shown thus
H.W.M.O.S.T. 1920
do. 1925
RIVER WELLAND
RIVER WELLAND
RIVER GLEN
VERNATT'S DRAIN
Feet 100 0 100 200 Feet

FIG. 1. Lugg Mill, looking up stream, before work.

FIG. 2.—Lugg Mill, looking up stream, after work.
The line x—x indicates the former level of water.

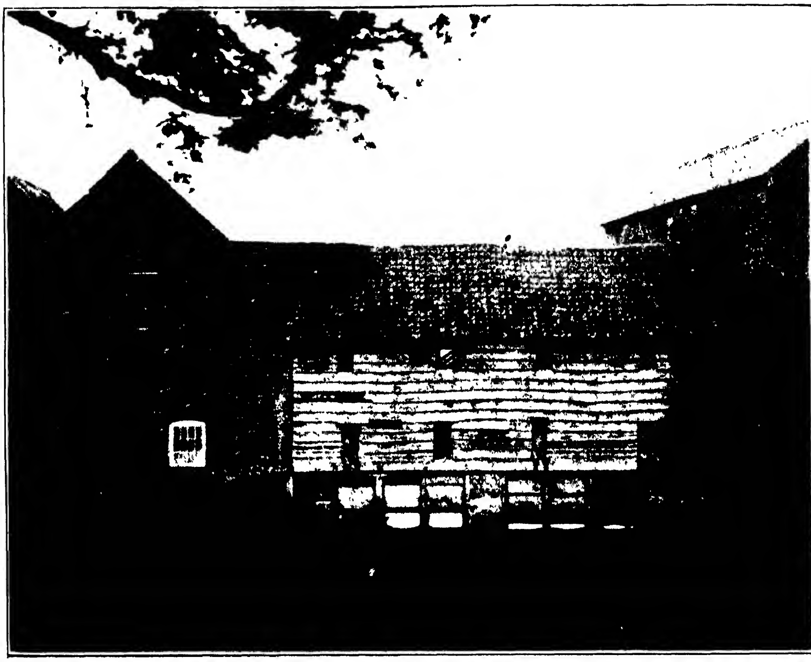
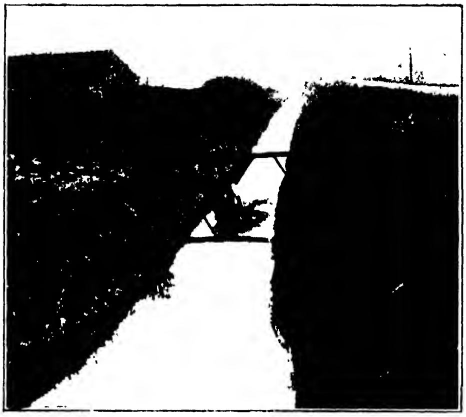


Fig. 3. Lugg Mill, looking down stream, before work

Fig. 4.—Lugg Mill looking down stream, after work.



Work in progress.

FIG. 5.—Bourne North Fen Drainage District – deepening and widening main drain.

FIG. 6. -R. Deben, East Suffolk, before work.

FIG. 7.—R. Deben, East Suffolk, work completed.

FIG. 8.—Woodbridge Brook, Wiltshire. Scheme in progress.

FIG. 9.—Woodbridge Brook, Wiltshire. Clearance completed.

FIG. 10. R. Wylye, Wiltshire. Scheme in progre

FIG. 11.—R. Wylye, Wiltshire. Scheme completed.

FIG. 12.—R. Wylye, Wiltshire. Before work.

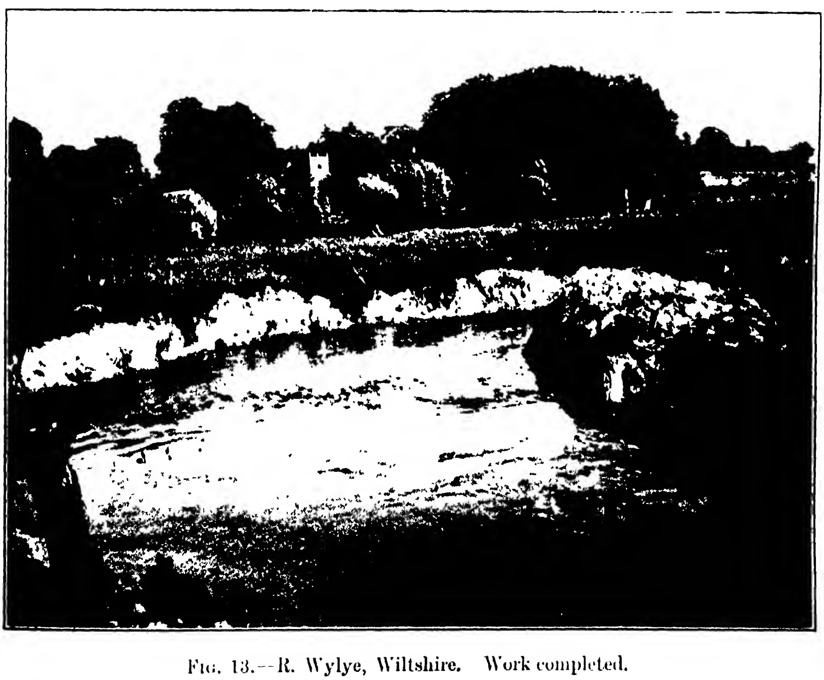


FIG. 13.—R. Wylye, Wiltshire. Work completed.

FIG. 14.—R. Lodden, Wiltshire. Before work

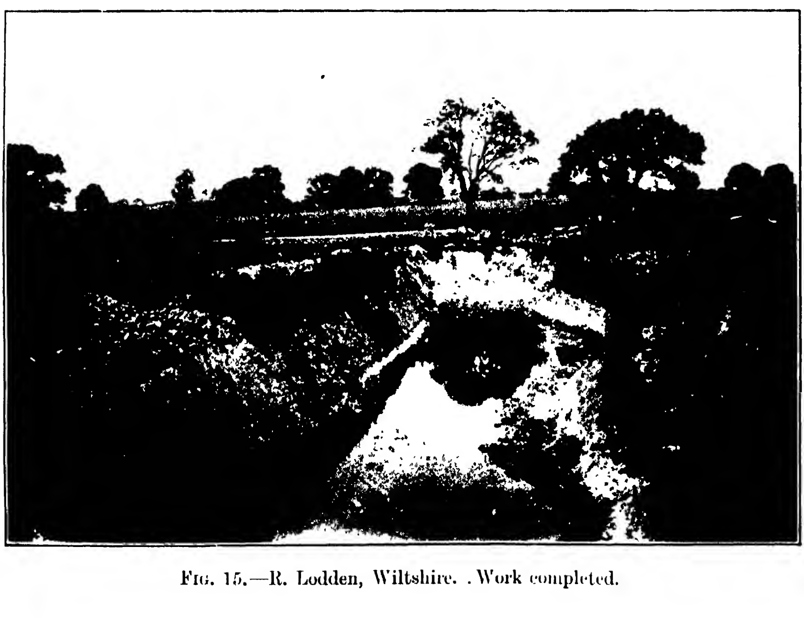


FIG. 15.—R. Lodden, Wiltshire. Work completed.

Results.—The photographs accompanying this report will serve to indicate the nature of the work accomplished. Where so many useful schemes have been in operation it is difficult to particularise, but the works illustrated may be taken as typical. One important scheme, for the restoration of the River Rother outfall at Rye Harbour was fully described in the June issue of this *Journal*.

The Meathop Marsh Scheme, a description of which was given in last year's report* has now been successfully completed. This scheme alone has provided 42,250 man days employment during the season under review.

The River Lugg Drainage Board accomplished a very successful river improvement by the removal of the derelict Lugg Mill Sluices. This progressive body acquired the mill rights, demolished that part of the mill which spanned the river and restored the channel to full efficiency. Figs. 1-4 give some indication of the nature of the improvement effected, and the benefit of such removal in flood time can be appreciated. This example might well be followed throughout the country, for many acres of land are permanently waterlogged through such neglected and obsolete dams.

A valuable piece of work was completed by the Welland Drainage Board. This scheme, which was commenced during the first unemployment grant season in 1921, consisted of training and redirecting the tidal scour at the junction of the Rivers Glen and Welland (see Diagram p. 592).

Many thousands of brushwood faggots or " kids " were used in this operation, the greater number of which had to be suitably sunk in deep water. Great difficulty was experienced in obtaining the necessary number of faggots, and the whole countryside was denuded of them.

The structure was consolidated by means of earthwork and turf obtained locally, and has proved effective in considerably improving the drainage outfall of some 30,000 acres of fen land. The Engineer to the Board proposes to develop these works further at the bend in the River Welland to be seen at the bottom of the sketch plan.

Summary.

(*a*) *Drainage.*—352 schemes for the improvement of arterial channels and subsidiary drains, resulting in the restoration of 1.667 miles of watercourses and flood embankments and benefiting 597,066 acres of land.

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* See this *Journal*, Oct., 1924, p. 612.

(*b*) *Sea Defence.*—34 schemes for sea defence, including the raising and strengthening of sea embankments, provision of timber groynes, repairs to sluices, etc., over a total length of 55 miles, and affording protection from tidal inundation to 71,463 acres.

(*c*) *Water Supply.*—76 schemes of water supply were executed, chiefly in the Cotswold district of Gloucestershire and in Wiltshire. This work included the digging and deepening of wells, provision of rams, pipe lines, reservoirs, drinking troughs, construction and repair of "dew ponds," etc. The Ministry's grant covered the cost of unskilled labour only in these cases, but the actual expenditure was at least three times the amount of the grant and afforded additional employment of labour both directly and indirectly.

Work under the Unemployment Grants Committee.—It is worthy of record that in addition to the winter unemployment work already described, provision has been made by the State through the Unemployment Grants Committee for grants in aid of works which, *inter alia*, can be certified as works of public utility by the appropriate Government Department.

These grants, which are available to all Local Authorities for all classes of work, are made on different terms and conditions from those of the Ministry, and their operation is not confined to the winter months, though this is understood to be encouraged as far as possible.

During the past 12 months the Ministry has been able to report favourably to the Unemployment Grants Committee on some thirty schemes estimated to cost approximately £70,000. These schemes included the provision of modern drainage pumping plants for the fens, sluices, dredgers, and schemes for the clearance of arterial drainage channels.

These schemes were estimated to provide an additional 3,000 direct man *months* employment, together with considerable indirect employment in the industrial centres where the orders for plant were placed.

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SYSTEM IN MAKING HEDGES.

G. H. HOLLINGWORTH,
Agricultural Organiser for Gloucester.

SPEAKING in a general way the hedges on farms in this country are open to severe adverse criticism. In the first place, surrounding and dividing fields there are miles of living fences that are never subjected to any treatment at all. The original thorn and other hedge plants have been mostly smothered out of existence by brambles, which have encroached into the adjoining fields to such an extent that acres of good land are lost for cultivation and production. It is not easy to find any reasonable excuse for this deplorable waste of good land, and in any scheme for increased production in agriculture these neglected and overgrown hedges, which stand condemned, should be rationally dealt with. Wild overgrown hedges tell their own story of long years of neglect, and the adjoining ditches, which in many cases are filled up, no longer serve their original purpose of carrying off surplus water, with the result that the adjacent land has become wet and sour. In other words hedges and ditches are an essential item in the scheme of farming, and the neglect of either or both inevitably leads to waste and under-production.

Another criticism is that in many cases where the hedges receive some kind of attention the work is badly done, either through lack of skill on the part of the operator or reluctance on the part of the farmer to allow the time that is necessary to make a good job. Lack of method and want of knowledge of principles explain reasons why many hedges are mutilated and spoilt. There is no system, the operator cuts without thinking, and he is not sufficiently concerned with the future of the hedge; as a consequence he makes bad cuts and cuts in the wrong places, and when these mistakes are made they cannot be remedied. The ill treatment of hedges, lack of method and bad workmanship give the impression that in many cases living fences are treated as a necessary evil, and must have a certain amount of labour bestowed upon them—but the latter is reduced to a minimum. This is obviously the wrong view, for good fences are essential in the economy of farming, and the plants of which hedges are composed should be looked upon in the light of a crop and be treated as such.

Methods in Hedging.—Turning to another side of the picture it is pleasing to observe that there are farms in perhaps every

district where due and proper care is given to the hedges, and farmers who take as much interest in their living fences as they do in the crops they grow. In each one of these commendable examples there is evidence of method, though the methods vary considerably in different parts of the country or even county. Some are doubtless better than others, but when any particular system of treating hedges is seen in a district, and the work is done well in accordance with that system, it may generally be taken for granted that there are good local reasons for the adoption of the method adopted. To condemn or even criticise other systems, and advocate the general adoption of any special one would lead to endless controversy, owing to the variation in local conditions, and the object of this article is to give an illustrated account of a method of laying and renovating hedges that is more or less common in several counties, and is meeting with favour in others where it has been introduced. The object is not to alter methods that are good and suited to local conditions, but rather to introduce method where none exists and to induce farmers and workers to take a pride in hedges and the display of good workmanship.

The System and its Objects.—The life of a white thorn or other hedge plant is limited, and if left severely alone it either becomes a tree or it dies out. One object then of cutting and laying is to maintain the plant as a hedge plant, to make a fence that will keep back stock and that is entirely alive, provided there is sufficient living material in it when it is taken in hand. Assuming that the hedge has been untreated for some years and has a ditch alongside, the object is take the brush through to the side opposite to the ditch, where it will provide resistance against stock. This will also allow for free growth of the young wood, to make a new hedge in the future, outside the fence on the bank above the ditch, instead of the new growth having to fight a crooked way up through the hedge itself. Fig. 1 shows the straight young growth obtained three years after the hedge was laid by the above method.

The Procedure Described.—The initial operation is to clear the bottom of the hedge of brambles, weeds and rubbish, and cut out any old decayed and useless stumps, but not thinning the hedge too much at the outset, as any superfluous material can be removed as the laying proceeds. It is important that in cutting the material in the hedge for the purpose of laying it this should be done as close to the ground as possible to encourage young growth to start at the bottom of the hedge, and

FIG. 1.—Showing young growth from the bottom of the hedge, three years after laying.

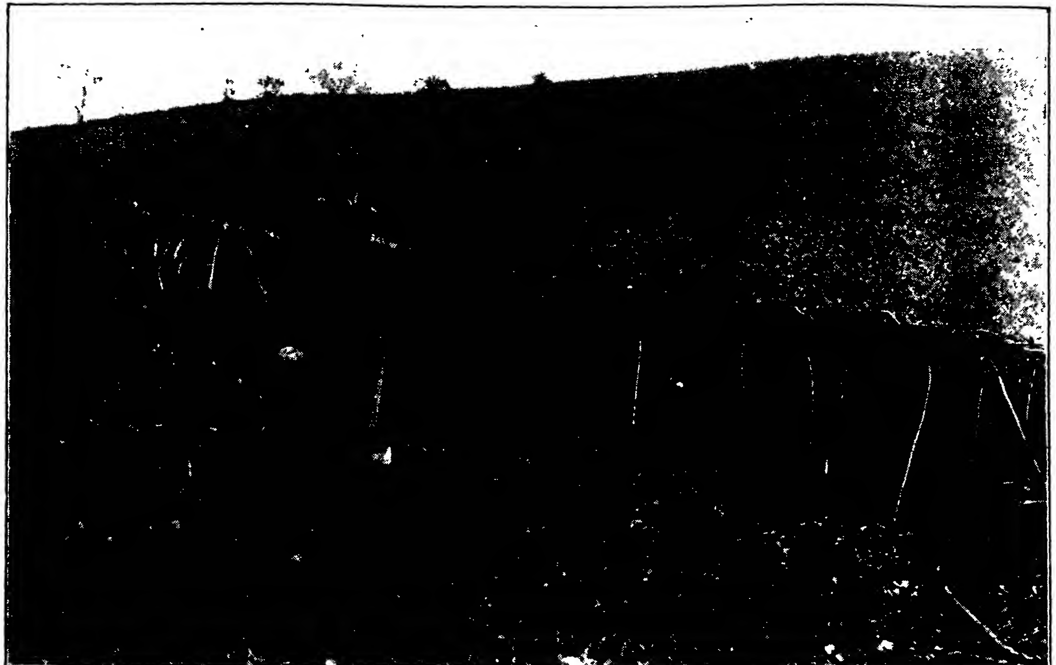

FIG. 2.—The finished hedge. Instructors work on the left. Pupils work on the right.

Fig. 3. —A bad hedge. The result of neglect and no method.

FIG. 4.—One year after cutting—dead binders and stakes used.

the sloping cuts should be clean and long. If the layers are not cut close to the ground the inevitable result is thick clumps or stowels in the hedge that are undesirable. Every yard or two leaning away from the ditch and from 8 to 12 inches out of the perpendicular are the stakes which strengthen the fence and give it rigidity, and wherever possible these stakes should be alive and growing. Whether live stakes are permissible in laying a hedge is a matter upon which opinions differ, and an argument against them is that they throw out a bunch of growth on the top. It is urged in favour of the live stake, however, (1) that it is firm and rigid, if the right growth is selected; (2) that even if it does throw out some shoots at the top the first year, the young vigorous growth from the base soon gets the upper hand; and, (3) that by using the material that is in the hedge for stakes considerable labour is saved in cutting material elsewhere and carting.

Binding the Hedge.—This procedure plays an important part in the system under review. As the work of laying proceeds an outlook is kept for long, straight and not too thick growths, a few yards apart and on the ditch side, or the opposite side to which the brush is carried through. When the laying is finished these binders or heathers are cut partly through at the bottom, bent the reverse way to the layers and interlaced between the stakes along the top of the hedge, thus making complete an entirely living fence. The work completed is shown in Fig. 2, with the difference that the left half shows the binders as they are laid by a skilled man and on the right by a pupil who was learning the art. It should be observed that the hedge when finished leans slightly out of the perpendicular away from the ditch, and the object of this is that the water drips off the hedge on to the ground instead of running down into the cuts and causing decay. The making of the ditch if required completes the process and when the hedge is laid first it is a comparatively easy matter to pare down the banks and place the material taken from the ditch along the hedgerow in such a way that it is not likely to smother up young growth.

No post and barbed wire fence is required to protect hedges when laid in the manner described, and if on the inside which is exposed in order to encourage the development of straight young growth, there is risk of grazing stock injuring the shoots coming up from the bottom of the hedge, this can be obviated by laying down the superfluous thorns that were cut out of the hedge but are not required for laying.

For purposes of comparison a piece of hedge illustrating neglect and no method at all is shown in Fig. 3, while Fig. 4 shows a hedge having dead stakes and binders, and in Fig. 5 there is another length of the same hedge, laid in the manner described in this article, and while the whole of the fence is alive, the young growth produced is far in excess of that in the other length of hedge.

Instructors and Instruction.—It is not infrequently stated that there is a danger of hedge-laying becoming a lost art, because most of the experts who can do the work really well are getting to be old men, and for one reason or another the younger men who might be expected to take their places are less skilful. If this be true, or even if there is a suspicion of truth in it, no further reason need be urged for the desirability of increasing the amount of instruction that is given in this important manual process. It is true that a number of agricultural societies encourage workers to become competent hedgers by arranging competitions and giving prizes, but as in too many cases there is no definite scheme of instruction, much the same competitors win the prizes year after year and the competition does not fulfil the purpose of making more good hedgers—which after all is the main object in view. If a youth or young man is to become a competent hedger he must be taught, and instruction should be centred on the young as it is difficult to get men to alter their ways when they arrive at middle age. The chief difficulty is to obtain capable instructors, for whereas there are a good many men who can cut and lay a hedge properly there are few who have also the knowledge and capacity for teaching others. The instructor in hedging should be a first-class workman, he should be able to defend his methods, to explain why he performs every operation in a certain way and what he expects to get as the result of doing it. To all these qualifications should be added the virtue of patience to ensure the ideal instructor.

The man shown in Fig. 6 with a specimen of his handiwork is Mr. G. D. Sykes, of Deddington, Oxon, who is an expert in thatching as well as hedging and has given a considerable amount of instruction under the Agricultural Education Committees in Gloucestershire and Oxfordshire, and the Lechlade United Hunts Agricultural Society. Mr. Sykes has proved his skill as a craftsman in upwards of twenty competitions, and possesses all those qualifications which go to make a successful instructor.

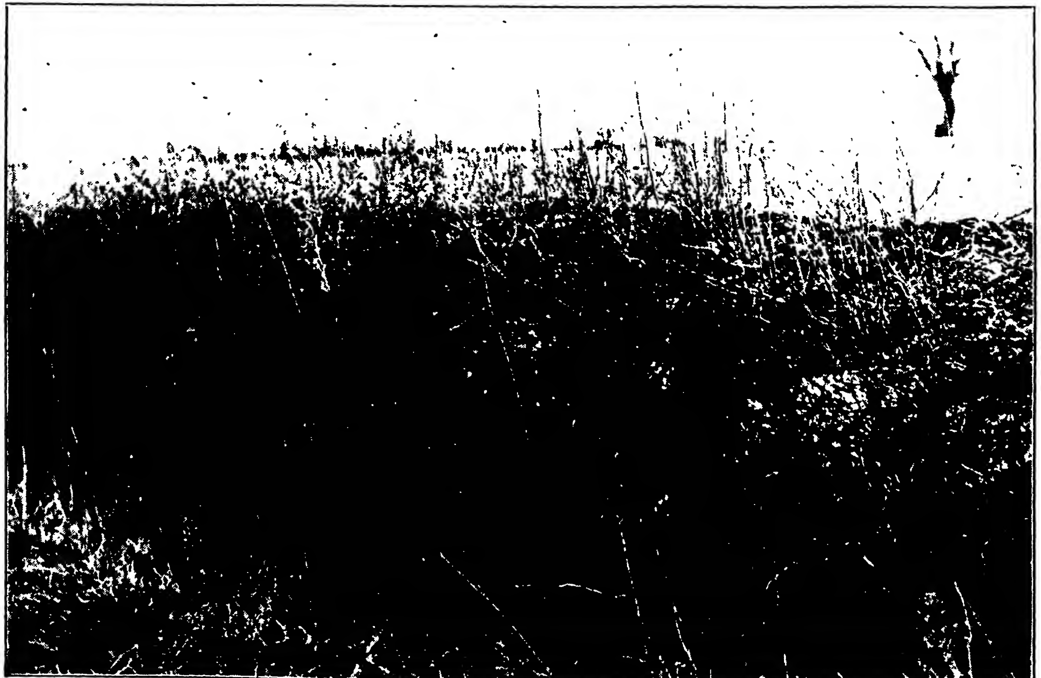

FIG. 5.—Another length of the same hedge showing 100 % more growth and all alive.

Fig. 6.—The Craftsman and his Work.

ORGANISATION OF LABOUR ON WELSH FARMS.

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PREVIOUS studies of the organisation and use of horse and manual labour on farms in England have given some useful and interesting results. When such studies can be carried a little further, especially as regards the time required for operations done under different conditions, they promise to yield some of the most useful of the results of farm costings in the sphere of internal organisation of farms. But the studies so far published have been those of the organisation of large farms or farms on which fairly large staffs were employed. The first study by Bridges was of the organisation of a large farm in the Eastern Counties which had about 80 per cent. of its area under the plough.(1) A subsequent study by Bridges included farms of several types, but the majority of these were arable farms, and few details were given for farms of other types.(2) The study by King related to two farms on which fairly intensive systems were followed and one dairy farm.(3) The results of these studies, interesting and useful as they are, are only applicable to farms of the types to which they relate, whereas there are large areas of England and Wales where farms of these types are not frequently found.

Hired and Family Labour on Welsh Farms.—In distinguishing types of farm organisation a useful distinction is that between farms on which most of the manual labour is supplied by hired workers, and farms on which the family of the occupier provide the greater part of the supply. Such a distinction might be drawn on general lines between the farms of England and those of Wales. In the former country the average position is that there are about three hired workers to one farmer. In the latter the labour supplied by the hired workers is less than that supplied by the occupier and his family, the ratio of the relative amounts for the whole country being about 1 : 1.5. Such a broad and general distinction, however, would be misleading, and more so in respect of English conditions

(1) Bridges: Labour Organisation on an East Midlands Farm. This *Journal*, July and August, 1922.
(2) Bridges: Farm Labour Organisation and Efficiency, *Farmer and Stockbreeder*, September 8th, 1924.
(3) King: Seasonal Distribution of Employment in Agriculture. This *Journal*, January, 1925.

than in those of Wales. The average ratio for Wales given above is a fair figure, for the highest ratio found is 1 : 1.13 in Flint and 1 : 1.14 in Denbigh, while the lowest ratio is 1 : 2.44 in Carmarthenshire, and there is no other county in which the ratio is lower than 1 : 1.95. There are a few areas in Wales in which, on the average, the amount of hired labour exceeds that supplied by the family of the occupier. These are most common in Flint and Denbigh. In every county of the Principality there are many individual farms on which the amount of hired labour exceeds that of the family labour. Still, there are even large farms on which family labour predominates; and over the whole of the farms the position is as shown in the figures above.

Useful as this distinction may be, it would be unfair to draw a distinction between the farm organisation of Wales and of England on the sources of supply of labour alone. There are many areas in England in which the type of farm organisation is very much similar to that of Wales. In parts of Cumberland, Westmorland, the West Riding of Yorkshire and of Devon and Cornwall one-half or more of the total labour on farms is supplied by the occupiers and their families. In fact, wherever hilly conditions exist this type of farm organisation tends to appear.

Divergences.—Moreover, in some of these English areas farming is mainly of the pastoral type, largely concerned with raising stock. Fields under permanent, or good, pasture and arable fields, or plots under arable crops, tend to be small. Both these conditions appear in a marked degree over great parts of Wales. Wherever these conditions occur the conclusions drawn from a study of the organisation or use of labour on farms which have larger and more convenient fields or larger groups of stock to handle, as in the Eastern or Midland Counties, do not apply. In fact, in one item, the results of study show directly opposite results. Bridges has shown(1) that the smallest demand for horse labour on an arable farm occurred in July, and this is believed to be a common feature of English arable farming. In the pastoral areas of Wales the heaviest demand for horse labour occurs whenever the hay-making begins, the heaviest demand generally arising in July and August.

There are, however, more important items in which divergences are shown. It is known that more horses are kept per 1,000 acres on small than on large farms,(4) and that the

(4) See Orwin : Uses of Costing, *Jour. Land Agents' Soc.*, September, 1923.

degree of utilisation of available horse labour on small farms is low. But few definite records from small farms are available. On the arable farm studied by Bridges(1) "the actual number of working days per horse during the year was 243.4 or 77.8 per cent. of the total possible working days." Figures collected by Ruston showed that the average time worked per horse on 11 farms was 216 days.(5) On four Welsh farms the records are available in hours, because the horses do not always work for a "day" when taken in for a task. The hours were as follows, the "day" being taken at 7 hours on the average for the year:—

Farm.	*Working Horses.*	*Hours Worked.*	*Equivalent Days.*	*Days per Horse.*
A	4	4,183	598	144
B	2	1,957	280	140
C	1	943	135	135
D	1	113	16	16

On the two farms on which only one working horse was kept there were no other horses of any description.(6) On each of the other farms a tractor also was worked, that on Farm A working 359 hours and that on Farm B 397 hours during the year. Farm D is perhaps not at all typical, for it was definitely understocked.

With regard to manual labour also there are differences between areas in which farms are large, with high proportions of arable, and those in which farms are small and mainly pastoral. In the former, a part, sometimes the major part, of the "casual" labour is of a skilled type, taken on for special tasks. In the latter the "casual" labour is often more of the type socially known as casual labour. In Wales it consists partly of persons of the "tramp" class, or at least of "summer workers" who have no special skill. In many pastoral districts men of the skilled worker type, depending for fairly continuous employment on many skilled tasks on several farms, are almost unknown. This class of worker, although often requiring high rates of pay, does not always supply "dear" labour. On the other hand, the real casual labour of the pastoral districts, especially of Wales, is apt to be costly, besides being to some extent a social nuisance on the farms. Yet in parts of Wales a considerable amount of the extra work on the larger farms during the heavy seasons is done by neighbouring small holders.

(5) Ruston: Cost of Horse Labour. This *Journal*, December, 1921.
(6) On such farms work requiring more than one horse is done by co-operation between neighbouring farms. Even where more than one horse is available, co-operation for certain tasks is common amongst small farmers.

Amongst the smaller farmers there is also a good deal of exchange of labour during these seasons.

Altogether there is just as much reason to seek for systems of cropping and stocking which will maintain a fairly steady demand for labour in small-farm pastoral districts as in the arable districts in which larger farms prevail. Indeed, where family labour predominates in the supply of regular workers, there is a peculiar need for regularisation of employment, for the whole of the family workers have to be maintained through slack seasons. There are districts in Wales in which farms are small and wholly of grass, on which the labour at certain times of the year is grossly in excess of requirements.(7) Possibly no system could be devised by which these workers could be fully employed at full rates of earnings equal to those of hired farm workers during all seasons of the year. Even in this case, any extra production which would provide only sixpence an hour for work done would make an addition to family income without entailing further costs.

The Actual Position on Four Farms.—The first essential of any attempt to indicate changes in methods is a detailed examination of the present position. Consequently, an initial endeavour to provide this has been made with the records of four Welsh farms. Details for each farm are available, but only the average position is shown here. The general system of farming on all the farms is described as "stock-raising and dairying." Only two of the farms carried flocks of sheep, and one farm contained $\frac{3}{4}$ of an acre of market garden, the labour on which is shown separately. The description of the land was as follows:—

		Acres.
Enclosed Arable	82	
,, Pasture	257	339
Hill grazings ...	...	250
Woodland ...	...	23
Total ...		612

The woodland is unimportant either from the point of view of labour requirement or that of stock maintenance; but the ratio of rough grazings to enclosed land is higher on these farms than for the Principality as a whole. It is more important that these farms were rather more heavily stocked than is generally the case over the whole of Wales. The average stocking over the whole year was:—

(7) Howell: An Economic Survey of a Rural Parish, p. 3, cf.

TABLE I.

	Numbers.	Per 100 Acres Arable and Enclosed Pasture.	Per 100 Acres Total Area.
Working Horses ...	8	2.36	1.3
Other Horses ...	7	2.06	1.12
Dairy Cattle ...	43	12.68	7.02
Other Cattle ...	71	20.94	11.6
Sheep	920	271.4	150.32
Pigs	40	11.8	6.53
Poultry	220	64.9	35.95

Besides the working horses, there were tractors on two farms. The actual amounts of labour applied to the land and stock is given below. The garden, 0.75 acre on one farm, took 2,328 hours of manual and 149 hours of horse labour. As will be seen, however, the live stock made by far the greatest demand for manual labour, while there was no such markedly predominant requirement of horse-labour, although arable crops provided the greater part of the employment for the tractors.

TABLE II.

Yearly Distribution of Labour Hours over Various Departments.

	MANUAL.		HORSE.		TRACTOR.	
	Hours.	Per cent.	Hours.	Per cent.	Hours.	Per cent.
Live Stock	20,849	55.25	1,334	18.94	136	18
Arable Crops ...	6,720	17.81	2,908	41.27	472	62.43
Hay and Pasture ...	4,126	10.94	1,724	24.47	84	11.11
Establishment ...	6,042	16.00	1,079	15.32	64	8.46
Total (excluding Garden)	37,737	100.00	7,045	100.00	756	100.00

Manual Labour for Stock.—It is unfortunate that the requirements of manual labour per acre of crops cannot be stated. The requirements per head of stock, however, are interesting:—

Yearly Manual Labour Requirements per Head of certain Classes of Live Stock.

	Average Numbers.	Total Labour Hours.	Hours per Head.
Dairy Cattle ...	43	9,138	212.5
Other Cattle ...	71	3,735	52.63
Sheep	920	2,469	2.68
Working Horses ...	8	1,317	164.6
Other Horses ...	7	165	23.6

There are considerable differences between the individual farms, notably in the case of the dairy herds, but the average figure gives about 23½ days per cow if the " day " is taken at 9 hours. For " other cattle " the figure is rather high and the rearing of cattle in Wales apparently requires more labour than

might have been expected. The working horses required a little less than half-an-hour per day taking the whole year. It has, however, to be remembered that the *working* "days" would be only about 130, which gives a result of a little more than 1½ hours attendance per day. Neither of these figures gives a fair result, but the average time in attendance on working days is probably about one hour per horse. Other horses, as is well known, require very little labour. The hours per sheep are low, but it must be remembered that one flock was very large, and all are grass sheep.

Monthly Distribution of Labour.—The monthly distribution of all types of labour over the departments of the farms show interesting results. In the case of the arable land, harvesting in the year 1920 was very late, and in a better harvest season more labour in September and less in October would be found. But a marked difference between these figures and similar figures for English farms is shown in every month. Late spring sowing of corn and high proportions of root-crops carry arable work late into the year. There is very little autumn cultivation and sowing of crops in the Principality as a whole.

TABLE III.

Monthly Distribution of Labour Hours over Various Departments.

Month.	Live Stock and Dairy.			Arable Crops.			Pasture and Hay.			Establishment.		
	Man.	Horse.	Tract.	Man.	Horse.	Tract.	Man.	Horse.	Tract.	Man.	Horse.	Tract.
January* ...	2,306	155	40	269	119	—	23	16	—	310	68	—
February ...	1,604	106	38	384	215	15	93	50	—	482	76	—
March ...	1,767	92	41	116	137	6	142	49	—	471	31	—
April ...	2,012	141	—	547	540	153	158	38	16	356	59	56
May* ...	1,799	111	—	652	384	62	99	81	—	482	194	8
June ...	1,406	126	—	566	380	25	52	48	—	701	108	—
July* ...	1,870	126	—	460	71	—	994	437	59	757	73	—
August ...	1,221	118	—	258	118	—	1,804	793	—	618	108	—
September	1,398	88	—	754	153	58	585	129	—	782	125	—
October* ...	1,946	91	—	2,023	487	46	38	20	—	410	71	—
November	1,763	79	17	530	234	97	110	59	12	283	38	—
December	1,759	102	—	161	70	10	28	4	—	390	128	—

* Denotes five-weekly periods.

The small area of market garden is not included here. The requirements of live stock and dairy show considerable variations from month to month, but the "months" of January, May, July, October are five-weekly periods and for comparisons with other months the amounts should be reduced by one-fifth.

The variations in the total demands for labour are shown in the following Table :—

TABLE IV.

Monthly Distribution of Labour.

Month.	Manual Labour Hours.			Horse Hours.	Tractor Hours.
	Total Hours.	Regular Hands.	Casual Labour.		
January*	3,111	3,047	64	360	40
February	2,881	2,593	288	470	52
March	2,704	2,684	20	350	47
April	3,233	3,132	101	777	224
May*	3,352	3,176	176	774	72
June	2,954	2,708	246	668	24
July*	4,300	3,686	614	707	58
August	4,216	3,187	1,029	1,155	—
September	3,691	2,887	804	495	57
October*	4,568	3,492	1,076	669	46
November	2,868	2,658	210	409	126
December	2,611	2,600	11	360	10
Total	40,489	35,850	4,639	7,196	756

* Five-weekly periods.

In connection with the department of "Pasture and Hay," the importance of haymaking in the labour economy of the farm is clearly shown in Table III, especially as regards horse labour. Some of the casual labour, especially on establishment work, consists of tasks not ordinarily undertaken by the regular staff, and this partly accounts for the fact that this labour is employed when the regular staff itself is not working the maximum of possible hours. This maximum varies, even with a fixed staff, with the hours of daylight and to some extent with the type of work which must be carried on. In February the 15 regular hands would be working an average of 7¼ hours per day for the 6-day week, or say about 6½ hours on weekdays and 4 hours on Sundays. In August, when they did most work, each would be working on the average about 9 hours per day of the 6-day week, or say about 8¾ hours on weekdays and one hour on Sundays.

The casual labour represents about 11.5 per cent. of the total manual labour, which compares with figures given by Bridges(2) ranging for groups of farms between four and seven per cent. It should, however, be noted that Bridges' figures were obtained from a greater total number of farms and for individual farms in his groups the figures were higher than on any of these four farms.

The concentration of horse labour in the months April to October is remarkable. It [illegible] would be difficult to suggest means of lowering [illegible] horse labour, except that of increasing the use of available horse power by varying crops. This occurrence of the heavy demand limits the possibilities of breeding, and the heavy requirements of hay-making cannot be met altogther by young horses which are being trained.

Conclusions.—There are some indications that the amount of manual labour required for growing cereal crops is greater in Wales than the six to seven days per acre required in England,(8) but a more detailed study now being conducted should reveal the position.

As regards live stock, present comparisons cannot be exact, for requirements are given in days, which are variable units. However, the estimate of 23½ days per dairy cow on these farms is fairly close to the 23 days given for England. In the case of "other cattle" the estimate is a little less than six days per head in Wales against over seven days for England. No fair comparison can be made in the case of sheep, for English records available are for "arable breeds" only. On the whole it appears probable that productive live stock may be as economically managed in Wales as in England.

It is in the effective use of horse labour that the chief weakness appears. Many Welsh farmers have been dependent on the horse market for reasonably cheap horse labour, and when demand is slack and prices are low their horse labour becomes expensive. Finding methods of lowering the cost of work done by horses will be largely dependent on increasing the work by growing more or more varied crops for feeding purposes. This again is dependent upon the success of investigations of variations in rotations under conditions prevailing in Wales. If more arable crops can be produced for the economical maintenance of live stock, greater use of both horse and manual labour will be possible. It is, indeed, on the intensification of live stock production that the more regular and intensive use of manual labour depends. There are farms where more stock could now be kept, if capital were available and markets opened up, without any increase in the present supply of manual workers.

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(8) Orwin: Work of the Agricultural Economics Institute, p. 7.

GRASSLAND IMPROVEMENT

THE Ministry has again directed the attention of County Authorities for Agricultural Education to the question of grassland improvement. It is anxious that the campaign for the improvement of grassland, so well begun in 1920 and continued during the past five seasons, should not fail in its due effect through not being followed up in the coming year. The full improvement effected by certain methods of treatment is not apparent for some years. It is therefore hoped that provision will be made by such authorities for continuing existing demonstrations (except such as may have proved to be unsuitably placed) as well as for commencing additional ones where practicable.

Co-ordinated Schemes of work on grassland problems are very desirable. Under the Ministry's scheme for the grouping of counties into provinces for agricultural educational work, such co-ordinated schemes of grassland experiments are suitably drawn up and supervised by provincial representatives from the different counties and of the agricultural college for the area. Suggestions for such co-ordinated schemes are made in Miscellaneous Publications No. 25 (post free from the Ministry on application). The following are now suggested as additional to the schemes published in that pamphlet where conditions are suitable :—

(*a*) Nationality trials with strains of red clover, such as are described below.

(*b*) Grazing trials, including careful account of stock grazed and live-weight and milk-weight increases per acre for the whole season from new sown leys or other grass of all descriptions.

(*c*) Substitution of Timothy for part of the ryegrass in temporary leys of more than one year on the heavier and/or wetter soils.

(*d*) Trials of dung and slag together on poor chalk land, for pasturage.

(*e*) Eradiction of Tor Grass or False Brome (*Brachypodium pinnatum* and *B. sylvaticum*) by burning where it is sufficiently dense, followed by severe harrowing with sharp straight-toothed arable land harrows and the application of a generous dose of phosphate (200 lb. phosphoric acid, P_2O_5, per acre). Where the Tor Grass is known to have been dense for years, a little wild white clover seed sown when phosphate is applied accelerates the improvement. Afterwards the land should be stocked as heavily as possible.

(*f*) Rotational treatment for hay. With the object of obtaining reliable information as to what kind of a hay crop can be produced with reasonably good manuring, and whether such crops pay (or

whether it might not be better to rely more on such crops as lucerne), some such rotational treatment as the following might be tried:—

1st year: Farmyard Manure (say 8 tons per acre).

2nd year: A suitable phosphate such as Basic Slag or Ground Mineral Phosphate (100 lb. P_2O_5 per acre).

3rd year: Nitrate of Soda or Nitrate of Lime (1 cwt. per acre).

4th year: Farmyard Manure.

On some soils a potash manure might also be included. In all manurial experiments on grassland the possibility of including a plot receiving a standard phosphate dressing only should be considered.

(*g*) Simple Summer Soiling Experiments. With a view to ascertaining the best green succulent herbage to supplement pasture or for animals housed during the summer (*e.g.* bulls, calves and horses or even dairy cows in spells of hot weather), lucerne might be compared with other green crops, a succession of which has usually to be grown in order to obtain a continuous green supply, for example, ryegrass and clover mixture, tares; comparative cost should be ascertained.

The two clovers most worthy of attention from the seed growing point of view are wild white and late-flowering red. Growing for seed might be encouraged either for the farmer's own use or for sale commercially.

Some more reliable records of grassland produce on different soils, in different districts, and with different systems of management are very desirable. Where farmers have carried out suggested high class treatments on fields more or less supervised by County Organisers or Advisers a simple record of the produce per acre would be useful.

Nationality Trials with Strains of Red Clover.—The following memorandum by Professor R. G. Stapledon on nationality trials with strains of red clover was prepared subsequent to a Conference held at Aberystwyth on 28th January last, when it was decided to conduct a nationality trial with red clover. It was also decided that Professor Stapledon should be responsible for obtaining the seeds and making up the mixtures.

"The experiment has been arranged on the uniform basis of plots 1/20th of an acre duplicated. The bed rock mixture will be as follows, in lb. per acre, viz.:—

Italian Rye-grass	2 lb.
Perennial Rye-grass*	6 "
Cocksfoot	8 "
Timothy	4 "
Rough-stalked Meadow-grass	2 "
The particular nationality of Red Clover ...	6 "
Wild White Clover	1 "

* I have been able to arrange to obtain what is probably indigenous Rye Grass taken from the cleanings of Wild White Clover, and I think the inclusion of this will greatly add to the interest of the experiment.

"For the purpose of readily identifying the plots, a minimum amount of chicory will be placed in each alternate nationality. The nationalities will be as follows, with and without chicory as shown :—

I. English Broad Red, plus Chicory, plus mixture.
II. Vale of Clwyd, minus Chicory, plus mixture.
III. Chilian Broad Red Clover, plus Chicory, plus mixture.
IV. Cotswold Late-flowering Red Clover, minus Chicory, plus mixture.
V. Montgomery Red Clover, plus Chicory, plus mixture.
VI. Cornish Marl Clover, minus Chicory, plus mixture.
VII. Swedish Late-flowering Red Clover (Svalöf), plus Chicory, plus mixture.
VIII. American Mammoth Red Clover, minus Chicory, plus mixture.
IX. Wild Red Clover, plus Chicory, plus mixture.
X. *Lotus Corniculatus*, minus Chicory, plus mixture.

"It has been arranged that all the seed for any one of the above nationalities shall be derived from one and the same source. Single plants will be grown at the Plant Breeding Station with a view to confirming the genuineness of each lot of seed. It will, therefore, be necessary that no conclusions are drawn from the plots until the genuineness of each strain has been confirmed, and this will apply rather particularly to the wild red clover.

"It will be realised that the Plant Breeding Station can hardly make itself responsible to offer any assistance in regard to the measuring out and sowing of the plots, as of course the sowing out of the centres will be round about the same batch of dates and will synchronise with the busy season at the Station. I can pretty well guarantee, however, that arrangements will be made for the staff of the Station to keep the plots at each centre under observation and from time to time to make the necessary botanical analyses and counts.

"The most important data to be obtained from this experiment will of course be persistency of the red clover and indigenous perennial rye-grass into the second, third and possibly subsequent harvest years. It is probable that a fairly good comparison will be obtainable relative to indigenous perennial rye-grass against commercial, and the inclusion of wild white and the exclusion of same by contrast to the ordinary farmers' mixture which will generally finish off the field.

"Organisers are particularly requested to provide the Plant Breeding Station with as exact information as possible relative to soil type, elevation, aspect, previous cropping and so forth of the centres at which it is proposed to lay down this important experiment.

"Germination tests will be made on all the samples of red clover and in making up the mixtures for the plots the seed rates will be adjusted in order to compensate for low germination. A schedule of germination will be sent out at about the same time as the mixtures are despatched."

FOOT-AND-MOUTH DISEASE RESEARCH.

THE Committee appointed by the Minister in March, 1924, to initiate, direct and conduct investigations into foot-and-mouth disease either in this country or elsewhere, has now presented its first progress report.*

Two previous scientific Committees have investigated foot-and-mouth disease. The first carried out investigations in India in 1912, but found the cattle, sheep and pigs of the plains of India in a high degree insusceptible to foot-and-mouth disease, and therefore unsuitable for experimental purposes. The other Committee was appointed in 1920, and its work was carried out on an obsolete warship and attendant lighter moored in the estuary of the river Stour, near Harwich. For various reasons the work of this Committee was brought to an end after eight months, and the Committee presented a report recommending, *inter alia*, that any future research work on foot-and-mouth disease should be carried out on land.

The present Committee has been given to understand that ample funds are available for several years for the purpose of carrying out very thorough investigations such as have been going on for many years in countries on the Continent. The Committee, which contains representatives of the most important veterinary and medical scientific institutions in Great Britain, was able to open several lines of investigation without loss of time and with exceptional facilities. The work dealt with in the Report was mainly carried out at the Ministry's laboratory at New Haw, near Weybridge, and the Lister Institute of Preventive Medicine in London. Some work has also been done at the University of Liverpool and at the Institute of Animal Pathology, Cambridge. The work at all these laboratories has been confined to experiments with small animals, but the Committee has had placed at its disposal by the Ministry, the cattle testing station at Pirbright, which has been converted into an experimental station for large animals.

* Obtainable from H.M. Stationery Office, Adastral House, Kingsway, W.C. 2, price 1s. 3d. net.

The station forms a closed compound and is surrounded by a barrier zone of farm lands, heath and open country from which live stock is excluded. The possibility of infection has received the closest attention of the Committee, who consider that the risk has been reduced to a minimum. As a result of the precautions that are being enforced, no undue anxiety need be felt that any spread of foot-and-mouth disease will occur from any of the investigations undertaken by the Committee. Experiments on cattle, sheep and pigs in Great Britain will only be undertaken at this station.

Soon after the Committee was appointed, Professors Frosch and Dahmen, of Berlin, published a report of their experiments, in which they claimed to have succeeded in rendering the virus of foot-and-mouth disease visible by photographic processes and in cultivating it in tubes outside the body for 25 generations. This report aroused the greatest interest, and the methods adopted by Frosch and Dahmen were subjected to re-examination in other countries. The work of Frosch and Dahmen was repeated by workers engaged under the Committee with all known precautions and with many variations, but in general it may be stated that their results have not been confirmed. At the Lister Institute the results were uniformly negative. At the Ministry's laboratory there were two experiments which appeared to be successful, but as these experiments have been repeated without obtaining similar results, they cannot be regarded as definitive.

Failing confirmation of the claims of Frosch and Dahmen, the Committee concentrated their efforts more and more on the study of the quality of the virus as it occurs in filtered fluids from the disease. Attempts were made to concentrate the virus by centrifugation and absorption, but no useful results were obtained. The effect of temperature on the virus has been studied to some extent, as well as the effect of glycerol, phenol, alcohol, chloroform, etc. It has been found that foot-and-mouth disease virus can withstand the action of alcohol for eighteen hours at room temperature. With the exception of the virus of the so-called " mosaic " disease of certain plants, there is no known parallel in the literature of filter passers.

One important aspect of foot-and-mouth disease investigation is the possibility of different strains of virus. The Committee is now investigating this question which may give the key to the solution of many of the remarkable facts which the practical study of foot-and-mouth disease has revealed.

An important advance in foot-and-mouth disease investigations was made in 1920, when Waldman and Pape showed that foot-and-mouth disease could be produced in guinea pigs. This has been confirmed by all subsequent workers and is now an established fact in the pathogenesis of the disease. A great many facts have now been established with regard to the course of foot-and-mouth disease in guinea pigs, and most of these facts have again been confirmed by the Committee, who are able to add some new results. Guinea pigs of different colours have been used, and whilst there is no evidence that colour as such possesses special significance, the weight of the animal has proved to be a factor of importance. The quickest and most severe reactions have been obtained with animals weighing 360 to 460 grammes. Various methods of inoculation have been tried and finally intracutaneous injection was selected as the most satisfactory. The most common incubation period of the disease in guinea pigs is 24 to 48 hours, when the local lesion or vesicle makes its appearance. The mortality of experimental foot-and-mouth disease in guinea pigs is about 5 per cent. and when recovery takes place it is found that a high degree of immunity has occurred. As evidence of the potency of foot-and-mouth disease virus, it may be mentioned that the actual fluid of the vesicles is frequently infective in a final dilution of one in a million. The Committee has come to the conclusion that the lesions in the guinea pig are specific, and that the virus does not deteriorate in passing from one guinea pig to another. In fact, one strain of virus after passage through guinea pigs for over a year, has reproduced typical foot-and-mouth disease in cattle.

Earlier experimenters failed entirely to communicate foot-and-mouth disease to rats and mice, but workers under the Committee have succeeded in doing so. In one instance, 55 wild rats were inoculated, and it was found that the local lesions were only slight, and by no means constant when the virus was injected into the pads of the feet, but when very large doses of the virus were given intramuscularly, it was found possible to recover it from the blood. Vesicles also appeared in some cases on the tongue.

White mice appeared to be immune to relatively large doses of virus, whilst a proportion of the house mice which were inoculated intramuscularly showed a transient infectivity of the blood. Long-tailed field mice, on the other hand, could be infected with great regularity, and in some cases vesicles

appeared on the tongue. Immunity was also proved to exist after the symptoms subsided.

Fowls and ducks proved insusceptible to foot-and-mouth disease, although the virus was found to remain alive in fowls from two to five days.

Although it is now definitely known that small animals can be artificially inoculated with the virus of foot-and-mouth disease, the Committee state that up to the present they have found no evidence that the disease can be spread by these small animals either under laboratory or field conditions. Indeed, all attempts to cause a natural spread of the disease among such small animals have proved abortive.

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COUNTY CLEAN MILK COMPETITIONS.

THE issue of this *Journal* for January last, p. 891, contained a note on some of the County Clean Milk Competitions held in the earlier months of 1924. Subsequent competitions indicate considerable further progress in the movement for the production of cleaner milk, and a general survey of the position may, therefore, be opportune. Twenty-six Local Education Authorities have held, or are now holding, at least one competition, and it is anticipated that by the end of the current year this number will have been increased to 34. It is noteworthy that in all cases where Local Education Authorities have instituted a competition, they have organised one in each subsequent year.

The schemes for competitions held since August, 1924, have been modelled on the lines outlined in the Ministry's Guide* issued at that date, the relative efficiency of the competitors being recorded in the form of marks based on conditions at the farm, as judged by inspection, and also on the scientific examination of the milk. In most cases the bacteriological examination of the milk has been conducted in the laboratory of the Provincial Agricultural College on account of the special facilities offered and the assistance that can be given to competitors by the advisory staff in conjunction with the county agricultural officials. Samples were forwarded periodically for examination as to bacterial content and keeping qualities, and in addition at least one "surprise" sample was taken by the inspecting judge on the occasion of his visit.

The results show that the competitions have fully realised their immediate objects of (1) demonstrating to dairy farmers and

*Miscellaneous Publications, No. 43, *Guide to the Conduct of Clean Milk Competitions*, price 6d. net, post free.

their employees that clean milk, which will keep well, can be produced without expensive plant or specially constructed buildings, and (2) cultivating in all concerned an intelligent interest in and appreciation of the essential conditions and methods necessary to produce milk of high hygienic quality. It has been clearly proved that whilst modern buildings may help from the point of view of labour, it is the methods employed rather than the buildings which ensure satisfactory results.

A marked feature of the laboratory reports is the considerable number of competitors who succeeded in producing milk of the standard of cleanliness required in " designated " milk.

In addition to the interim reports which are usually circulated to competitors after each round of samples or surprise visit, many Authorities have now issued final printed reports dealing with all aspects of their competitions. Those published in connection with the 1924 competitions for Yorkshire and the four northern counties have already been summarised in the April, 1925, issue of this *Journal*, pp. 76-78; the following particulars, extracted from other reports, will, however, serve to illustrate the educational value of these competitions.

North Dorset Competition.—This competition, open only to producers in North Dorset, was held from September to December, 1924, and attracted 21 entries despite an outbreak of foot-and-mouth disease. 168 samples of milk were examined for bacterial content, 101 of which reached the standard laid down for Grade A milk; and of this number 62 fulfilled the requirements for Certified milk. Further, 25 per cent. of all the samples examined gave counts of not more than 10,000 bacteria per c.c. These figures are of particular interest in view of the fact that holders of licences to produce designated milk were ineligible to compete. There was, however, no examination of milk for keeping qualities, and the examining centre mentions this fact with regret as the keeping quality test gives precise information which specially appeals to the consumer.

Of the 21 competitors, 9 obtained over two thirds of the maximum marks and only 2 failed to reach half marks. Copies of the *Report on the North Dorset Clean Milk Competition* issued by the County Agricultural Committee may be obtained from the County Offices, price 6d. each, post free. Another clean milk competition organised by the Dorset Agricultural Committee in conjunction with the Melplash Agricultural Society commenced in July, 1924, and extended to July, 1925. It was open to producers in West Dorset, and there were 10 competitors; the Local

Authority hope to organise a competition for the remainder of the county in the near future.

Somerset Competition.—The Somerset competition, held over a period of 4 months from November, 1924, to March, 1925, attracted 68 entries, the largest number yet recorded. In this case again producers of Certified or Grade A milk were ineligible to compete. Of the 330 samples of milk examined 220 reached Grade A standard, and of these 126 gave a count of bacteria within the requirement laid down for Certified milk. Thus there were more samples up to Certified standard than there were below Grade A. Furthermore two-thirds of the total samples were up to designated standards, and it was found that 80 per cent. of the samples kept sweet and untainted for two days and 15 per cent. for more than that period.

The printed report on the Competition, issued by the Somerset Agricultural Sub-Committee includes full details of awards. With the permission of the competitors concerned a list is appended of those whose samples attained at least Grade A standard in the last round. It is satisfactory to note that 52 competitors obtained this result as compared with 31 in the first round. Over 30 competitors' samples reached designated standards on 4 occasions of the 5, and only 5 competitors failed to reach them on at least one occasion.

Midland College Inter-County Competition.—This competition, organised by the Midland Agricultural and Dairy College in conjunction with the Local Education Authorities of Derby, Leicester, Lindsey and Nottinghamshire, was held over a period of 6 months from October, 1924, to March, 1925, but for the first 4 months it was limited to the respective counties. The four winning competitors from each of Derby, Leicester and Nottinghamshire and the three from Lindsey then competed for the inter-county awards for which there were thus 15 candidates. During the whole period 354 samples were taken from 49 farms and examined, but the report issued by the Midland College, entitled *Report on the Inter-County Competition, 1924-25*, only deals with the later phase.

In the Inter-County Competition 150 samples were examined, of which 82 (54.7 per cent.) reached Certified and 18 (12 per cent.) Grade A standards. The average duration of sweetness of the samples in the first round was 58.8 hours and in the last 66.4 hours. Outstanding features of this competition were the extreme keenness of the competitors and their workmen, the production of clean milk in unpretentious buildings and the

very considerable improvement in the cleanliness of the milk during the course of the competition.

The first three prizes were won by competitors from Nottinghamshire, Leicester and Derby respectively, and in addition 9 proficiency certificates were awarded. Thus of the 15 competitors in the inter-county competition only 3 failed to obtain awards.

Other County Competitions.—Competitions on similar lines were organised during the winter of 1924-25 by the Committees responsible for agricultural education in *Middlesex*, *Gloucester*, *Devonshire*, *Kent* and *Wiltshire*. Particulars of these are shown in the following statement:—

County.	No. of Weeks.	Competitors.	No. obtaining about ⅔ possible Marks.
Middlesex	16	9	7
Gloucester	13	13	10
Devonshire	13	15	9
Kent	13	45	38
Wiltshire	13	39	34

In the case of the Wiltshire competition, it is of interest to note that one competitor entered a herd of goats, for which a special class was formed and a special prize awarded. This competitor was 6th in order of merit in the whole competition.

In all the reports on these competitions stress has been laid on the number of small tenant farmers who have competed successfully, and further the immense improvement in conditions on the farms and methods employed during the course of the competitions. This must indeed have been the case for such excellent results in regard to bacterial content and keeping properties to have been achieved.

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CORRESPONDENCE CLASSES IN AGRICULTURE.

THE Ministry has directed the attention of Agricultural Education Authorities to the question of agricultural correspondence classes, with a view to their possible development.

An interesting series of correspondence courses in agriculture was arranged last winter by the Agricultural Education Authorities for Derby, Lindsey, East Suffolk, East Sussex and Anglesey. The classes were intended for young men and women, engaged in agriculture, who were unable to attend farm institutes or take advantage of organised class instruction, and were designed to arouse their interest in the principles under-

lying the ordinary farming operations in which they take part in their everyday occupation. The experiment was confined to relatively small classes conducted by the Agricultural Organiser or, under his supervision, by a member of his staff. Each student was lent the books recommended for the study of the selected subject, except in one county where the students themselves purchased the text book (price 2s. 6d.). Papers were set weekly or fortnightly, the corrected papers usually being returned with a model set of answers and notes for the next lesson.

The courses commenced in January and lasted from 10 to 12 weeks. On the whole the students were regular in returning their answers and a large proportion completed the course, but when the evenings lengthened and farm work increased there was a tendency for the numbers to fall off. In one case a fee of £1 was charged, 13s. 4d. being returnable to the students completing the course. In this instance all the students were tenant farmers. In the other cases no fees were charged and the students, whose ages ranged generally from 17 to 19 had been engaged on farm work since leaving the elementary school. As a rule the questions were based on local conditions, to avoid mere repetition from the text book and to enable the students in writing their answers to make use of their local practical training. Some students undoubtedly suffered from a lack of general education and had difficulty in expressing themselves on paper, but the work of the best students was very good. Generally speaking, those taking the courses showed great keenness and appreciated the opportunity of gaining instruction.

In one area the County Branch of the National Farmers' Union offered prizes for the three best students. In another, the Local Authority gave cash prizes of £3, £2, and £1 to the 3 students gaining the highest marks, and certificates to all those who obtained 75 per cent. of the maximum, and a third county presented the 3 best students with copies of Professor Somerville's book on "Agriculture."

The Organisers concerned were unanimous in stating that the experiment has been of much value, and that as a means of bringing agricultural instruction in an economical form to those who cannot take advantage of other available facilities the system is worthy of an extended trial. It is understood that all the authorities who took part in the experiment are continuing the classes during the coming winter; in some cases an advanced class of last year's students will be arranged as well as classes for new students. The main criticism on last winter's work

is that the courses commenced too late; instruction should take place from October to March, as after March work on the farm becomes too pressing for the students to give a satisfactory amount of time to their reading.

The following is a summary of the reports of the classes:—

Derby.—The course consisted of 12 lessons lasting from January to June, in Plant Hygiene, Animal Husbandry and Veterinary Science, and the text books used were Russell's "Students' Book on Soils and Fertilisers," Porter's "Stock-feeder's Companion" and Thompson's "Elementary Veterinary Lectures." Each lesson contained directions as to the text to be read, additional notes and comments and a set of questions to be answered and sent in for correction. In Animal Husbandry special notes were sent on matters not dealt with in the text book. Eight students enrolled, the majority continued up to the eighth lesson, when probably owing to pressure of farm work the number fell off. The best students reached a high standard of efficiency, and seemed better than day class students. Others were not so capable of self-instruction.

Lindsey.—The class consisted of 14 students from 17 to 19 years of age, of whom 12 completed the course. Ten lessons were given and the book selected for study was Somerville's "Agriculture." The book was divided into 10 parts, each part forming the lesson for one week's study. Notes explaining any points of difficulty or throwing fresh light on a particular problem connected with the lesson were sent with the test papers. After the course had ended the Organiser received letters from past pupils relating to something seen on their farms, and inquiring whether their own interpretations were correct.

East Suffolk.—The course lasted from January to May, and 11 students joined, of whom 8 completed the course. The book chosen for study was Somerville's "Agriculture." A fortnight was allowed for the first lesson; thereafter a fresh set of questions was sent out weekly. All except one student obtained over half marks in the aggregate. The Organiser adds: "The chief difficulty that I can see is the fact that the students one would most like to see joining are rather deficient in general education and hence find it difficult to answer questions."

East Sussex.—Preparatory to the commencement of the course a meeting was held at Iford when the scheme was explained to a number of possible students. Twenty-nine students enrolled, and it is probable that all would have completed the course but for an outbreak of foot-and-mouth disease which compelled a number to discontinue. Of the remainder, 16 completed the course,

showing no sign of slacking off towards the finish. As the majority of the students were engaged on farms producing certified milk and where the cattle were rationed in accordance with the county's rationing scheme, the text books selected were Mackintosh's "The Feeding of Dairy Cows," and Mattick's "The Production of Clean Milk." The course started in January and lasted 11 weeks. The general standard of education was good and the answers returned were regarded as very satisfactory.

Anglesey.—The students were drawn from two districts. The classes started early in January and continued until the middle of April. The course comprised 5 lessons and notes were given on each. Eleven pupils entered for the class, and of these 7 sent in answers to the papers, but owing to the calls of farm work, only 3 completed the course. The quality of the work done was good.

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TRAINING IN COMMERCIAL POULTRY KEEPING.

J. HUNTER-SMITH, B.Sc., and D. W. FERGUSON, N.D.P. (Hons.),
Hertfordshire Institute of Agriculture.

IN July, 1923, an article was published in this *Journal* describing the poultry plant which had then just been established at the Hertfordshire Institute of Agriculture.

It was stated in that article that the objects of setting up the plant were as follows:—

(1) To demonstrate a system or systems of poultry keeping which actual accounts will show to be profitable, and which could be copied in the county with similar results.

(2) To provide the means of training young men and women in all details and processes in successful and profitable poultry keeping.

The intention was also expressed of publishing figures at a later date to indicate whether in actual practice the plant proved worthy of the hopes entertained at its inception.

It is appropriate to mention first that the second of the objects in setting up the plant is being attained. The plant has proved of the utmost utility from the point of view of giving instruction of the most practical kind in poultry keeping to all the agricultural students at the Institute, and also enabling a number of young men and women to specialise very thoroughly in commercial poultry farming.

The main object of this article is, however, to set out some results, financial and otherwise, which have been obtained in the past year.

As a series of figures is not likely to be of much interest or value by itself, it seems desirable to recapitulate some of the features of the plant from which they have been obtained.

A One-Man Plant.—In the first place, it should be pointed out that it has been found possible to maintain the plant at a strength of 900 birds instead of 800 as originally intended.

The whole plant is under the supervision of the County Instructor in Poultry Keeping, the actual management being done by an experienced working poultryman. This man can usually undertake all the work involved, but some assistance is necessary during the season of hatching and rearing.

Three breeds are kept, namely, White Wyandotte, Rhode Island Red and White Leghorn, while a number of first-cross pullets are reared each year.

The birds are housed in units of 100 in simple but substantial houses, 30 ft. by 14 ft. (illustrated in the previous article). There are 12 such houses, three of which are reserved for chicken rearing, two (each sub-divided into two) are used for breeding pens, while the remaining seven accommodate the laying flock. Four of these seven laying houses are now in one enclosure, and two in another enclosure for the first crosses. The remaining house is at present divided into two for a comparative test of wet and dry feeding.

The separation of the first crosses was found advisable for several reasons, and it also enables a comparison to be made of the laying properties of these crosses with those of the pure breeds from which they were derived.

Rearing.—Hatching is done mainly by incubators, though a number of birds are brought up under hens in the simple, natural hatching plant previously illustrated. Incubator chicks are transferred straight to cabins, 6 ft. by 6 ft. by 6 ft., in which a hover is placed for the accommodation of 70 to 80 chicks. At 6 to 8 weeks old, the chicks are taken to the large houses reserved for them, where they are kept, divided in small lots of about 30, till they have learned to perch. In order to maintain the flock up to establishment, approximately 1,200 chicks are reared annually. Half this number may be pullets; 450 of the best are selected and drafted into the laying houses and the remainder sold. Cockerels are disposed of locally or in the London market.

General Management.—All the pure bred pullets are trap-nested for four months each year from October to January. This enables the breeding pens to be made up from pullets which have proved to be good winter layers, while all birds which do not come up to a certain standard are weeded out.

The importance of trap-nesting is apparent.

In each case these trap-nested pullets were all reared in the same way at the Institute, and they represent selected birds. The parents were on one side trap-nested home-bred pullets, selected on egg records for a place in the breeding pens, and on the other side cockerels which were not always obtained from the same source. The result as shown in the table is a variation in individual yield from 0 to 89 eggs in 119 days. During the trap-nesting period from 4th October to 31st January, no eggs were collected from 29 birds (15 Rhode Island Reds, 10 Wyandottes and 4 Leghorns). In other words, during this period 8 per cent. of the Rhodes, 10 per cent. of the Wyandottes and 6 per cent. of the Leghorns appeared to be entirely unproductive.

The following are a few of the records obtained last winter :—

TRAP-NEST RESULTS FROM 4TH OCTOBER, 1924 TO 31ST JANUARY, 1925. (119 DAYS.)

—	182 Rhode Island Pullets.		100 White Wyandotte Pullets.		66 Leghorns.	
	No. of Eggs.	Percentage of Possible.	No. of Eggs.	Percentage of Possible.	No. of Eggs.	Percentage of Possible.
Average	39.5	33.2	21.0	17.6	23.2	19.5
Best 10 { Lowest	78	—	45	—	37	—
Best 10 { Highest	89	—	67	—	57	—
Average	83.4	70.1	51.7	43.5	47.1	39.6
Best 50 { Lowest	54	—	20	—	14	—
Best 50 { Highest	89	—	67	—	57	—
Average	68.5	57.6	34.6	29	28.5	23.9
Worst 10 { Lowest	0	—	0	—	0	—
Worst 10 { Highest	0	—	0	—	10	—
Average	0	0	0	0	3.5	2.9
Worst 50 { Lowest	0	—	0	—	0	—
Worst 50 { Highest	25	—	19	—	31	—
Average	9.5	8.0	7.5	6.3	16.9	14.1

These figures are certainly very suggestive. Unfortunately, the birds in one house out of five were not trap-nested, and a certain number of eggs may not have been recorded. In future, special precautions will be taken to get reliable confirmatory figures.

The elimination of unproductive birds at an early date is most desirable from every point of view. Unfortunately it does not appear to be possible to detect non-laying pullets with certainty in September or October.

Cost of the Plant.—The whole plant, according to the specifications previously given, was put up at a cost of approximately £950, to which has now to be added £50 to cover the cost of an adequate food store. A cost of £1,000 for a 900 bird plant (including live stock) works out at £1 2s. 3d. per bird; exclusive of live stock the cost was £880, just under £1 per bird.

Other Results: Egg Yield.—The number of eggs collected over a period of 18 months is shown in the following table:—

EGG YIELD IN THE HALF YEAR OCTOBER 1923-MARCH 1924, AND THE FULL YEAR APRIL 1924-MARCH 1925.

	Actual No. of eggs laid.	Percentage of possible.	Actual No. of eggs laid.	Percentage of possible.
			1924	
April	—	—	13,661	50.6*
May	—	—	12.997	46.6
June	—	—	10,659	39.4
July	—	—	10,340	37.0
August	—	—	8,915	31.9
September	—	—	6,689	24.8
	1923			
October	2,218	8	6,662	23.9
November	2,972	11	5,828	21.5
December	6,035	21	6,780	24.3
	1924		1925	
January	6,760	24	8,712	31.2
February	9,554	36.6	9,752	38.7
March	11,885	42.5	13,298	48.0

Six month periods.		Actual No. of eggs laid.	Percentage of possible.
October 1923 to March 1924 (inclusive)	...	39,424	23.9
April 1924 to September 1924 (inclusive)	...	63,261	38.4
October 1924 to March 1925 (inclusive)	...	51,032	31.3

The improvement in egg yield again shows among other things the value of trap-nesting.

In the year April 1924 to March 1925 (inclusive) the return was at the average rate of 127 eggs per bird or 34.8 per cent.

* In the 30 days of April, with 900 birds the maximum possible is 27,000 eggs, and this number of eggs would be 100 per cent. Actually 13,661 eggs were laid or 50.6 per cent.

Size of Eggs.—Of the total eggs produced, 86 per cent. were first grade, about 12 per cent. second grade and less than 2 per cent. were broken or damaged. In connection with the last figure, mention might be made of the importance, first of having a system whereby production is checked and recorded, and, secondly, of following this a stage further so that the sales accurately tally with the production records. Of course, this is elementary business, but it is surprising how often, whether in the case of eggs or milk, there is a discrepancy between these two sides of the account.

Total Sales.—The total sales during the year from April, 1924 to March, 1925 (inclusive), amounted to £1,124 3s. 1½d., divided as follows:—

	£	s.	d.
Eggs	890	17	1½
Old Hens and Cockerels	182	7	11
Sittings	24	3	0
Day old Chicks ...	15	1	0
Sundries	11	14	1

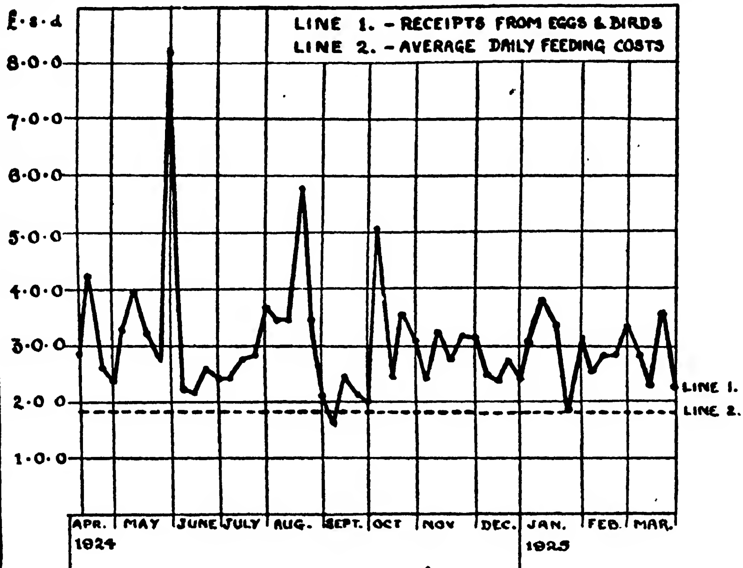
The first graph shows the total sales plotted from weekly averages. The three high peaks are occasioned by the sale at these times of cockerels or hens. On the average, receipts amounted to £3 1s. 3d. per day.

An interesting point is brought out in the second graph where a dark line shows the eggs produced throughout the year, and the dotted line the return from eggs at wholesale prices. The peak in egg production was a shortlived period in April, and there is a steady and consistent decline in the rate of production from this month till the curve shows a flat bottom in October, November and December, when the output of eggs is at its lowest.

Comparing the production line with the dotted curve (which shows the average daily cash receipts from eggs only) it is at once apparent that receipts from eggs were maintained at a comparatively level rate. While production varied within a range of from 2 to nearly 5, this is compensated by a price variation of from 3s. 7d. to 1s. 3d. per dozen, bringing the income fluctuation within the much narrower limits of 2 to 3.

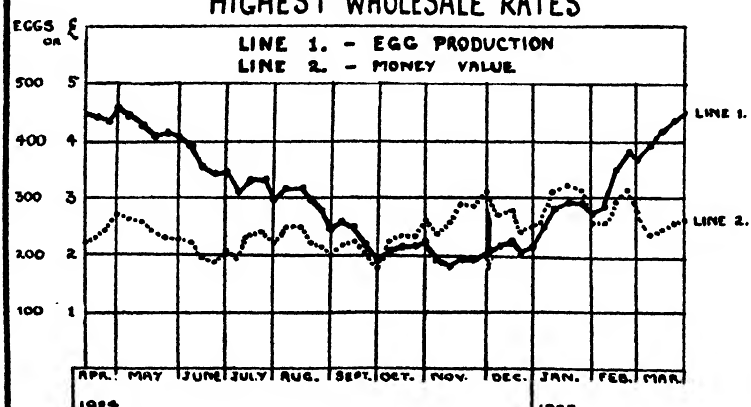
The highest average daily returns from eggs did, in fact, tend to occur at the periods from October to January when production was lowest and prices highest. These facts do not, of course, take into account the cost of production. Doubtless, winter costs are higher, but in the case of poultry enclosed in runs, the difference between winter and summer costs cannot be very great.

GRAPH 1. SHOWING AVERAGE DAILY RECEIPTS IN WEEKLY PERIODS FROM 29TH MAR. 1924–28TH MAR. 1925.



	£ · s · d	
AVERAGE DAILY RECEIPTS FOR YEAR	3 · 1 · 3	FROM 900 BIRDS
AVERAGE DAILY FOOD COST	1 · 16 · 1	
AVERAGE DAILY INCOME FOR LABOUR, RENT, STOCKBIRDS, PROFIT, ETC.	1 · 5 · 2	OR £458·5·10 PER ANNUM

GRAPH 2. DAILY EGG PRODUCTION IN WEEKLY PERIODS AND AVERAGE DAILY RETURNS FROM EGGS ONLY IF SOLD AT HIGHEST WHOLESALE RATES



NOTE THAT VALUE FLUCTUATES WITHIN NARROW LIMITS

Financial Results.—Trading and Profit and Loss Account for the year, 1st April, 1924, to 31st March, 1925, is given below.

POULTRY DEPARTMENT.

Trading and Profit and Loss Account from 1st April, 1924, to 31st March, 1925.

	£ s. d.	£ s. d.		£ s. d.	£ s. d.
To Valuation, 31/3/24 (Plant, Live Stock and Eggs) ...		1,195 6 7	By Sales :—		
Purchases and Expenses :—			Eggs	890 17 1½	
Rent and Rates	34 17 9		Sittings of Eggs	24 3 0	
Food stuffs	658 0 11½		Day old Chicks	15 1 0	
Cockerels and Eggs... ...	26 5 0		Old Hen and Cockerels ...	182 7 11	
Oil for Incubators	10 10 5		Sundries	11 14 1	
Casual labour (including hire of horse and implements)	34 15 8				1,124 3 1½
Repairs to plant	19 13 0		Valuation, 31/3/25 (Plant, Live Stock and Eggs) ...		1,156 17 6
Carriages and Postages ...	6 15 3				
Manures and Disinfectants...	3 4 3				
Sundry Requisites	7 7 0				
		801 9 3½			
Balance		284 4 9			
		£2,281 0 7½			£2,281 0 7½

D

In the initial valuation, the full cost of the plant, namely, £880, is included, whilst in the closing valuation this figure has been reduced by 5 per cent. to allow for depreciation.

Rent amounts to £3 per acre or £27 in all. The only item for labour is an inclusive charge for such casual labour, hire of horses, etc., as was actually used.

The balance or profit of £284, therefore, represents the return which the manager of the plant would receive to recompense him in two directions:—

(*a*) For the capital invested in the business, and

(*b*) For his own regular labour.

These results are probably a very true indication of what can be expected from a one man plant of the kind described, situated near a town, in its first year.

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EXPERIMENTS ON KEEPING APPLES IN OILED PAPER WRAPPERS.

DURING recent years, the question of storing the later varieties of home-grown apples in order to market them some months later in the season has aroused much interest amongst English fruit growers, and the practice is a growing one.

The large majority of the apples which are stored in this country are kept unwrapped. A small quantity may be wrapped in newspaper or waste paper, whilst still fewer are wrapped in tissue paper. The object of wrapping the apples is to enable them to be kept in marketable condition for a longer period.

In North America, much use is being made of paper impregnated with absorbent substances, such as odourless mineral oil, for wrapping apples. In this country, attention was first directed to the use of such oiled paper in 1921, when in the course of experiments conducted by the Food Investigation Board of the Department of Scientific and Industrial Research, it was found that the use of oiled wraps had the effect of reducing and delaying spot development on apples in both gas and cold storage. Further experiments, a short account of which is given in the Annual Report of the Food Investigation Board for 1922, showed that the storage life of samples of Bramley's Seedling apples was prolonged at least 6 weeks by using oiled paper wraps.

In order to focus the attention of growers on this subject, and with a view to discovering the effect of oiled wraps on

different varieties of apples in ordinary cool storage, a series of experiments was carried out under the supervision of the Ministry's Inspectors in the principal fruit-growing centres during the winter of 1924-25. Apples wrapped in oiled paper and in ordinary paper, and unwrapped apples, were packed in standard boxes and placed in storage sheds, and on subsequent examination comparisons were made of the condition of the three groups of apples.

At Centre No. 1, some rather scabby specimens of the variety "Blenheim Orange" (season November to January) were stored on 28th November in a well-ventilated outhouse with thick brick walls. On 16th February 12 apples of each group were examined, when it was found that two of the oil-wrapped apples were rotten and one half-rotten, amongst those in ordinary wraps one apple was partly rotted, whilst the unwrapped apples were rather badly scabbed, one was rotten, and two half-rotten.

At Centre No. 2, the apples chosen for experiment were "Newton Wonder" (season November to February), "Charles Ross" (season October to December) and White apples. They were not boxed, but were stored in trays in a cellar on 26th November and at that date were scabbed and bruised. When examined on 19th January and again on 11th February, it was found that the percentage of bad apples amongst the unwrapped apples was slightly greater than in the case of the wrapped apples.

At Centre No. 3, "Newton Wonder" apples were stored on 24th October in an ordinary apple store. The unwrapped apples were not stored in boxes but samples were laid out on shelves. Twelve apples from each lot were examined on 11th February. The wrapped apples were all found in perfect condition; the unwrapped apples had shrivelled very slightly, one had a small bruise, whilst another was partly rotten.

Three other experiments were made with the variety "Newton Wonder." In each case the apples were stored on 8th October in ordinary storage sheds, and were examined on 16th February. In one case it was found that 5 per cent. of the apples in oiled wraps were bad, while 20 per cent. of those unwrapped were bad. In the second case 4 per cent. of the oil-wrapped apples were bad as against 5 per cent. bad amongst the unwrapped apples. In both these experiments the colour of the fruit was improved by the oiled wraps. In the third case, two of the oil-wrapped apples and two of the unwrapped

apples were found to be bad. Where the apples were scabbed before wrapping there was no improvement in their appearance.

At Centre No. 7, "Cox's Orange Pippin" (season November to March) were stored in an ordinary storage shed on 8th October and examined on 16th February. The apples in oiled wraps showed 4 per cent. bad, whilst 5 per cent. of those unwrapped were bad. The apples in oiled paper wraps lasted in good eatable condition two weeks longer than the unwrapped apples.

Three experiments were made with the variety "Bramley's Seedling" (season November to March). In one case the apples were stored on 8th October in an ordinary storage shed and examined on 16th February, when 2 per cent. of the apples in oiled wraps and 3 per cent. of those unwrapped were found to be bad. The colour of the apples was improved by wrapping in oiled paper. In the second of these experiments, the apples were stored on 8th October in an ordinary storage shed. On examination on 16th February, one of the oil-wrapped apples and two of the unwrapped apples were bad. In this case the colour of the wrapped apples was not superior to the unwrapped apples. In the third experiment with this variety, the apples were stored on 17th October in an ordinary packing shed and examined on 27th February. The condition of the apples at that date is indicated by the following table:—

	Perfect	Blemished or Spotted	Half-Rotten	Rotten	Total
Oiled wraps	114	3	0	3	120
White paper wraps	86	24	6	4	120
Unwrapped	47	43	18	12	120

The apples in oiled wraps had retained their bloom and their general appearance was much superior to the others. None of them was affected by spots, whilst 20 per cent. of those in white paper wraps and 36 per cent. of the unwrapped fruit were spotted. The wrapped apples had each lost 1 lb. per box and the unwrapped $1\frac{1}{2}$ lb. per box in weight.

At Centre No. 11, the apples were of the variety "Lane's Prince Albert" (season January to March) and were stored on 8th October in an ordinary storage shed. When examined on 16th February, 4 per cent. of the oil-wrapped apples and 10 per cent. of the unwrapped apples were found to be bad.

At Centre No. 12, the apples were a late russet similar to "Golden Russet" (season December to March). They were stored on 3rd November in a stone and wood shed with an

earth floor. A preliminary examination was made on 26th December, when in th [illegible] were found due apparently to scab, in the [illegible] wrap " box one apple had [illegible] " unwrapped " box the apples were as sound as those in the other two. When a further examination was made on 31st January, it was found that in the " oil-wrap " box [illegible] apples had gone bad, in the " ordinary wrap " box another completely rotted apple was found and the fungus had spread to the apples touching it, whilst no change was evident in the " unwrapped " apples except that they had withered to some extent. There was practically no shrinkage in either of the wrapped boxes.

At Centre No. 13, " Hanwell Souring " apples (season February to April) were stored on 21st October, the boxes being placed on their sides on the earth floor of a hop oast where the temperature was between 32° and 39° F. On preliminary examination being made on 16th December, one apple in each of the 3 groups was found to be rotten, whilst in addition one of the unwrapped apples was badly bruised. The boxes were re-packed and placed on end in potato trays. A final examination was made on 23rd March, when the condition of the apples was found to be as indicated in the following table :—

	Perfectly clean and sound	Saleable but somewhat shrivelled	Unsaleable owing to rot or other blemish	Total
Oiled wraps ...	91 ...	35 ...	12 ...	138
Ordinary paper wraps	101 ...	17 ...	8 ...	126
Unwrapped ...	71 ...	49 ...	16 ...	136

Of the unsaleable apples, one had turned quite black and contained mycelium of *Sclerotinia fructigena.* In the majority of cases the rot appeared to be mostly due to the fungus *Penicillium expansum.*

In the last experiment the apples were a little-known variety named " Peacemaker." They were stored on 8th October in an ordinary storage shed and examined on 16th February, when 2 per cent. of the oil-wrapped apples and 4 per cent. of those unwrapped were found to be bad. The fruit in the oiled wraps kept in good eatable condition six weeks longer than the unwrapped fruit.

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SOME RECENT WEEDS IN THE SOUTH-WESTERN COUNTIES.

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Hawk's Beard.—The Large Rough Hawk's Board (*Crepis biennis*, L.) and the Small Rough Hawk's Beard (*Crepis taraxacifolia*, Thuil.) are grouped in the present case, as they have often been confused. Both are biennials and the treatment for eradication is similar. In the South Devon area only *C. taraxacifolia* is of economic importance. The Large Rough Hawk's Beard is a stouter plant, the stem is not so branched, and is more leafy; the flower stalks are shorter and thicker. In the Small Rough Hawk's Beard the leaves at ground level are more numerous, frequently showing a deep purple tint, which is sometimes also evident on the stem, the flower heads are smaller, and the whole plant is more hispid. The most prominent distinction is in the fruit—in *C. taraxacifolia* it has a long beak, whereas in *C. biennis* there is no beak. Both are plants of roadsides, hedges and waste places.

Growth commences early in the spring, about March or April according to the season. In the second year the flowers appear in June or July, the seeds being scattered in August and September, when the plant dies.

Life History.—As both plants are biennials, leaves only are produced during the first year. They generally form a close tufted rosette at the surface of the ground, crowding out all other vegetation near them. The rooting system is deep and they are therefore capable of withstanding great drought when other plants are completely burned up. This was very noticeable during the drought of 1921. A large number of flower heads (*capitula*) are produced, giving rise to plentiful seed capable of germination. Owing to the way the rosette of leaves covers the ground in the earlier stages of the plant's growth, there is at seeding time much bare ground on which the seeds can fall and germinate. This explains the tendency of these plants to occur in dense patches crowding out every other plant near them.

Distribution.—The distribution of these plants in the south-western counties is distinctly local. The botanical records for Devon and Cornwall show that these plants were far from common before the war, but since that time they have increased and in several areas are now very plentiful. Fre-

quently they are found on railway embankments and sidings, and sometimes they invade adjacent agricultural land. This, of course, tells its own tale: the seeds are being distributed along the line from goods trains where the plants are present in straw, hay and packing. *C. taraxacifolia* is mentioned in the flora of Wilts in 1888. Briggs, in his "Flora of Plymouth," records it in 1880 as a colonist. In Davey's "Flora of Cornwall" the first mention apart from the Plymouth area is near Bude in 1886. In the Supplement to the "Flora of Cornwall" by Thurston and Virgurs (1922) it is recorded as increasing at an alarming rate, and it is stated that there are records of hayfields being affected.

C. biennis is still comparatively rare and there are only a few records, although it is recorded previous to *C. taraxacifolia*. Before 1916 there were no records of the latter in the parish of Highweek, South Devon, yet in 1920-21-22 it was more than plentiful on the grass banks around Seale-Hayne Agricultural College, particularly where some military huts were erected while the College was a hospital. This indicates the source of the seed. There have also been several cases of hayfields which were a forest of these plants, to the serious detriment of the grasses and clovers. The origin of the seed in these cases is problematical: it must have been introduced with the seeds or with manures or packing, since the neighbouring hedges and fields were free from the weed. The presence of Spotted Medick suggested the introduction with shoddy and other waste products, but this could not be proved.

Recently there has been a remarkable spread of these plants (*C. taraxacifolia*) along the G.W.R. line, Torquay branch, and in some places the embankments are a solid mass of them. Evidently this species is being freely distributed at the present time, since extensive patches have appeared where there were previously none.

Eradication.—The life history of these plants shows that there are two stages for successful eradication:—(1) The rosette stage. (2) Just before the flowering stage. In the rosette stage spudding will remove the leaves and severely damage the plant, and in most cases they will not survive. This method can be readily adopted in pastures or in hayfields after cutting.

During the second year of growth cutting must take place in the *early* flowering stage. If the flowers are well formed and the stems are then cut, there will be sufficient food stored in the stem to enable seeds to be set.

These methods have proved very successful in the eradication of the weeds. In the course of three years if these methods are adopted the weed will have practically disappeared, but for a few dormant or hard seeds in the soil which may possibly germinate much later than the normal time.

Rayless Mayweed.—Rayless Mayweed (*Matricaria discoidea*, DC.) is very similar to Scentless Mayweed, but differs among more evident features in the absence of any florets of the ray (the white outer part of the daisy-like head). It has the stem covered with leaves at more frequent intervals, and has more scent or odour. It seems at first sight to be a small stunted form of scentless mayweed.

This plant is not a native ot this country, but is found in North America, Asia and Europe. It has been introduced into this country within very recent times. The first record from the south-west is by Davey in the " Journal of Botany," 1900. Since then it has spread considerably and is quite common in some localities.

Distribution.—The plant occurs in waste places, on sandy banks, railway sidings and embankments, canal banks, roadsides and the surroundings of harbours and farm buildings. It does not seem to be restricted by soil conditions and may be found on totally different types of soil, sometimes invading cultivated fields. The seeds are heavy and have no float and are simply scattered over the surface of the ground by the wind or with wet earth attached to the feet of animals, cart wheels or boots. Its distribution is increasing rapidly, for in the south-western counties it is now to be found in many districts where it did not previously occur. One interesting point recently noted by us is that where bricks and tiles for building purposes are imported from the Continent and dumped down with straw and packing, this plant is not infrequently to be found growing a few months later. We have not been able so far to prove that the seeds are introduced with the packing, but as the plant did not grow there previously it is very significant.

Life History.—The plant is an annual and may be found growing from April to September, according to the season. It sets seed, and seeds down very quickly, especially in the southwest, and there may be two or even three generations in one year. This is one of its most valuable assets in rapid spreading, for even in the interval between successive weedings some of the plants may produce seed. Shortly after the seed is scattered the plant dies.

Presence in Cultivated Areas.—In grass land the plant is seldom found, either the grazing or the competition with other plants being unfavourable. Only occasionally will it be found creeping in at gates or near the road-side, and under such circumstances it occurs on bare patches of soil—never among the grasses and clovers. There is no evidence that it is likely to be a danger to grass land.

In arable land it is another matter. In one recent instance the seed had been conveyed into a field by a gateway opening on to a main road. The crop was barley, and an area at the gate spreading out fanwise over nearly half the field was smothered with Rayless Mayweed. It formed a dense mat-like growth crowding out every other plant, the crop being reduced by 50 per cent. Subsequent cultivation has prevented a recurrence. There are many farms where this weed is found surrounding the farm buildings so that its distribution and spread is a constant danger. There are records of crops being seriously damaged in Cornwall and also in Herefordshire. Doubtless there are other cases which have not been recorded.

Eradication.—The usual method of destroying the plant is constant cultivation and the prevention of seeding. This cannot always be achieved as it depends upon the crop. Round buildings and in waste places near a farm any weed-killer, salt and water, or copper sulphate will be effective in removing the source of danger. In cereals, copper sulphate might prove effective if applied in time.

Another method which has been adopted is deep ploughing. The chief objection is that some day the buried seeds will come to the surface and the trouble may have been only delayed. When the weed is very plentiful a change in the rotation and an extra root crop would be most effective in keeping it in check and also killing most of the plants.

Soft Knotted Trefoil (*Trifolium striatum*, L.).—This plant is a typical trefoil or clover occurring in dry pastures and waste places. The only plants it might be confused with are Teasel Clover (*T. maritimum*, Huds.) and Haresfoot Trefoil (*T. arvense*, L.). Teasel Clover is confined to the sea coast, but Haresfoot Trefoil has the same habitat as Soft Knotted Trefoil. Soft Knotted Trefoil differs from Teasel Clover in having flower heads without stalks, and its stipules are not so long and narrow. Haresfoot Trefoil has long cylindrical flower heads which are very hairy, while the leaflets are narrower than Soft Knotted Trefoil.

Life History.—Being an annual it commences growth early in the spring, flowers in summer, and dies down shortly afterwards. The length of life, however, depends on the season. In a dry season its life will be much [illegible] than in a wet season, while under fa[illegible] may be two generations in one sea[illegible] conditions the plant is semi-prostrate and [illegible] above ground level, but when growing among tall herbage it may reach a considerable height. Plants growing under such conditions have been received which were over a foot high.

Presence in Cultivated Land.—This plant was first brought to our notice as a weed in 1923 when it was sent for identification from Bude in north Cornwall. Shortly afterwards further specimens came from Bideford in north Devon, near the Bude district. In both areas it was growing among cereals and smothered the crop. It is rather unusual to find such a plant giving trouble, and it was rather puzzling at first to explain how it suddenly became a troublesome weed. The districts are near the sea, although the fields concerned lie some distance inland. The soil in these districts is deficient in lime, and lime is generally a costly item. In Bude, as in many other parts of Cornwall, where the soil is acid, it is customary to use the sand from the dunes and the coast as it contains an appreciable amount of carbonate of lime in the shells. This was dealt with by Borlase and Gregg in this *Journal* for Oct., 1922. It is just where the sand is taken from that *T. striatum* occurs, and when the sand is removed and scattered on cultivated land the seeds of this plant are introduced with the sand. It is natural that under such favourable conditions and with a good soil Soft Knotted Trefoil will flourish and produce a vigorous growth.

Eradication.—The plant is an annual, and prevention of seeding is therefore the essential point. Much can be done by thorough cultivation, especially in the case of a root crop. In pasture it is not likely to cause any trouble, and being a legume may have a distinct value, especially on dry, poor pastures. In hay also it is not likely to have much, if any, deleterious effect, since the grasses and other clovers will keep it in check. The plant itself is not poisonous, but being hairy might not be greatly relished by stock.

Among cereals, however, the plant presents a rather different problem. Owing to its hairiness, spraying with copper sulphate (except in a very young stage) will have little or no result, and

if the spray is made stronger so as to have greater effect the cereals will suffer severe damage. In the younger stages an application of sulphate of ammonia at the rate of about 2 cwt. per acre is the only method of dam[illegible] the plant. This method cannot always be adop[illegible] ditions, and one must be guided by the [illegible] deciding on the nature of th[illegible] ammonia can be used it not merely scorches and kills the trefoil but stimulates the cereal, which is a double advantage. It is not likely, however, that this plant will be more than an occasional weed, and even then only under rather unusual circumstances.

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AN EXPERIMENT ON FEEDING SILAGE TO DAIRY COWS.

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IN this *Journal* for June, 1924, an account was given of two feeding experiments with silage carried out during the early part of that year. They were regarded as of a preliminary nature to be repeated as circumstances permitted.

In one of those experiments, carried out at Overhall Farm, the comparison was between a ration containing both roots and silage and one containing no roots but a large allowance of silage. In substituting an additional amount of silage for the roots, the assumption made was that "in compiling a maintenance ration 1 lb. of silage may be regarded as equivalent to 2 lb. of roots." Owing to the variable nature of roots and the still more variable composition of silage, it is a rough rule of this sort which is likely to be of the greatest value to the practical man.

Besides being an attempt to test the soundness of this assumption, the experiment was designed to show that large quantities of silage could be fed safely to heavy milking cows without affecting the milk yield adversely. On this point much doubt still lingers amongst farmers, causing them to hesitate before embarking on the making of silage on a large scale.

During the past winter, by kind permission of A. S. Bowlby, Esq., we were given an opportunity of repeating this particular

experiment with the same herd of Friesian cows, and it is thought that the results may be of sufficient interest to merit publication.

We would like to express here our thanks to Mr. Bowlby, and also to record our appreciation of the extreme care and exactness with which Mr. Craigie and his head cowman carried out the feeding and recording.

Plan of the Experiment.—This was almost exactly a duplicate of last year's, but it extended over a longer period, namely, three months. Ten cows were selected and placed in two groups well balanced as regards total milk yield and the stage in the lactation period reached by the individual cows. The groups were given a fortnight in which to get accustomed to the experimental ration; they were then recorded for a month: during the next fortnight the groups were changed over on to each other's rations and then followed a second experimental period of one month.

The Silage.—This was from a seeding of 1½ bush. tares, 1 bush. beans, 1 bush oats, and ½ bush. wheat per acre. The crop was an excellent one, yielding when cut in early July 11 tons of green material per acre. A sample of the silage taken in January gave the following analysis:—

	per cent.		*per cent.*
Water	74.6	Soluble Carbohydrates	10.2
Crude Protein ...	3.2	Fibre	8.0
Crude Oil	1.4	Ash	2.6
			100.0

Estimated starch equivalent 10.5 lb. per 100.

Rations.—The rations used were:—

	Ration 1. *lb.*	*Ration 2.* *lb.*
Mangolds	42	—
Swedes	14	—
Silage...	25	50
Hay	14	14
Oat Straw Chaff	4	4

The basis of substitution is 25 lb. silage equals 56 lb. roots, or approximately 1 lb. silage equals 2 lb. roots. The maintenance parts of the rations were, therefore, practically identical with those of 1924.

In addition, for every gallon above the first, 4 lb. of the following mixture were fed to both groups:—

Cotton Cake ...	1 part.	Bean Meal ...	1 part.
Linseed Cake ...	2 parts.	Barley or Wheat...	1 „
Dried Grains ...	1 part.	Fish Meal ...	5 per cent.

After 4th February this was changed to:—

Linseed Cake	... 1 part.	Wheat or Barley	1½ parts.
Dried Grains	... 2 parts.	Oats ...	... ½ part.
Bean Meal...	.. 1½ .	Fish Meal	... 5 per cent

At the commencement of the experiment, no difficulty was experienced in getting the cows to eat their full ration of 50 lb. silage. As in the previous year, however, the oat straw was either completely omitted or only a small amount consumed.

The first recorded period was the four weeks from 14th January to 10th February. The period of two weeks from 11th February to 24th February was allowed for the groups to change over to each other's rations. The second experimental period was the four weeks from 25th February to 24th March.

	Root Ration, 14th January to 10th Feb.		Silage Ration, 25th February to 24th March.	
GROUP A. 5 cows.	Average yield per cow 14th Jan.	Average yield per cow 10th Feb.	Average yield per cow 25th Feb.	Average yield per cow 24th March.
	46 lb.	44.6 lb.	35.8 lb.	37.1 lb.

	Silage Ration, 14th January to 10th Feb.		Root Ration, 25th February to 24th March.	
GROUP B. 5 cows.	Average yield per cow 14th Jan.	Average yield per cow 10th Feb.	Average yield per cow 25th Feb.	Average yield per cow 24th March.
	43.6 lb.	43.6 lb.	39.0 lb.	38.5 lb.

Results in Milk Yield.—The results are presented in the table and diagram. The table shows the average daily yield per cow on the first and last day of each recorded period. In the diagram, the averages per head over successive three day periods are given. This smooths out the minor fluctuations which would be shown by plotting each day's average and therefore shows more clearly the general progress of the results. During the first period (14th January to 10th February) both groups maintained their yield well, the advantage, if any, lying with that on the silage ration. But, as is shown very clearly in the diagram, a very different result was obtained during the second period. After the change over there was a rather rapid falling off in both groups which was practically identical up to 21st February. (This falling off

may be attributed to the change of food, but it was accentuated by a very cold spell of weather with frosty nights; the other cows in the herd also dropped in their yield during these few days.) After 21st February, the group which was now on roots steadied, and the yield thereafter showed only a normal gradual decline. The group on silage, however, continued to drop very rapidly for two more days, reaching the low daily average yield of 35.8 lb. The explanation of this drop was supplied by the cows themselves. Hitherto the 50 lb. silage had been readily consumed, but now the cows refused a large portion of it. On examination it was found that a different layer of silage had been reached. The sample analysed in January was a good specimen of acid silage ensiled under good conditions, but that reached towards 20th of February was in appearance a much inferior sample, more fibrous and chaffy, suggesting that the crop had been over mature when cut. The analysis, however, was very similar to that of the previous sample. In spite of this similarity, the cows evidently found it much less succulent and less appetising as they now refused their full ration.

The sudden change on to an inferior sample of silage gave a very severe check to the cows from which the yield only slowly recovered, and at the end of the second experimental period there was still a difference in average daily yield of 1½ lb.

Cost of the Two Rations.—As both groups received the same amount of concentrates, the difference in cost per cow per day is the difference in cost between 56 lb. roots and 25 lb. silage. The root crop, with a yield of 20 tons, worked out at 17s. 4d. per ton, and the silage, with a yield of 11 tons, at 19s. 9d. per ton.

If the output of milk had been the same for both groups, this would have meant a difference of 2.58 pence daily per cow in favour of silage, or for a 3-gallon average just over 0.8 pence per gallon.

The actual output of milk, however, was as follows:—

Root Ration.		lb.
Group A.—14th January to 10th February	...	6,348
,, B.—25th February to 24th March	...	5,466
Total	...	11,814

Silage Ration.

Group B.—14th January to 10th February	...	6,107
,, A.—25th February to 24th March	...	5,239
Total	...	11,346

Difference in favour of root ration = 468 lb. = 46 gallons in 56 days.

Value of this at 1s. 8d.	£3	16	8
Against this has to be placed the extra cost of the root ration, 56 days for 5 cows at 2.58d. ...	3	0	2½
Net difference in favour of root ration	£0	16	5½

Summary.—From this experiment and from those conducted last year there is afforded a measure of confirmation of the practical soundness of the formula—1 lb. good silage = 2 lb. roots.

It is clear that cows relish good silage and will eat readily amounts up to 50 lb. daily.

This year's experiment, however, shows that any change from a sample of good silage to one less palatable is at once reflected in the milk yield. The falling off may be a very serious one from which the cows only slowly recover.

It would also appear that under circumstances where only average yields of roots are obtained, silage may prove an economical substitute for roots in the rations of dairy cows.

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CHARTS AS AIDS TO LECTURING.

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THE methods adopted by lecturers in presenting informative matter upon agricultural subjects to rural audiences are slowly passing through a period of transition. Visual aids such as lantern slides, the blackboard, and charts drawn on paper by the lecturer beforehand, are gradually taking the place of the

text-book, and make ... pression. Thomas Edison, the gre ... time text-books as a medium fo ... obsolete, and that " visual education " will be a matter of course in all our schools, the printed lesson being largely supplemental.

For some years the writer lectured in rural areas upon the subject of poultry-keeping, on the lines of the text-book, but discontinued this method, owing to the difficulties met with, due to differences in age, degrees of intelligence and education of those present at the lectures. All do not possess the powers of perception and comprehension in equal degree; and to meet varying needs, the information must be presented in such a lucid manner that any person, even though unacquainted with the subject, can comprehend it and utilise the knowledge obtained.

Almost every person engaged in rural pursuits ignores the scientific side. Using scientific terms at lectures tends to mystify the audience, they become confused and lose all interest in the subject under discussion and the value of the lecture is lost.

In order to meet these difficulties and objections to the use of science and text-books, the writer evolved a series of illustrative charts which were used originally as blackboard sketches. These charts avoided the use of technical phrases, and for several years they have been in constant use and demand throughout the county of Wilts. Disappointment has been expressed when they have not been used at lectures.

Charts make ideas clear to the audience which cannot be adequately expressed in speech. Impressions conveyed through the eye are retained, but the ear forgets; things seen and observed arrest attention and assist the memory, and thus become valuable aids to the mind. Verbal instruction requires constant reiteration to be retained, but the eye memorises easily.

How the Charts Originated.—While lecturing during the period of the war to secondary school pupils and head teachers of elementary schools upon the subject of practical gardening it was suggested that a series of sketches on the blackboard in coloured chalks be given illustrating " Pictorial Gardening." This was done, and those attending the course made copies and used them in teaching in their own schools. It was found in practice that the scholars readily absorbed the methods employed through the use of direct illustration. They cleared

away difficulties, impressed facts, and [illegible] applied much more easily than if given only through verbal instruction.

For a number of years sketches in chalk were continued at poultry lectures, but blackboard illustrations were by nature ephemeral and they were finally converted into charts of a permanent nature. From observation over a period of years it has been found that the system of chart lecturing has been the means of spreading information which has been put into practice by many farmers, smallholders, etc., and much benefit has been derived from it.

The Method of Preparing Charts.—The Charts used are made as attractive as possible. The unattractive illustration does not centre attention and the mind and thoughts are deflected into other channels. Many persons attend lectures out of mere curiosity and are critical; charts check this tendency and curiosity is aroused. Such persons are given cause to think, their powers of thought are developed along sound lines, and attention is held leading to concentration. Charts should be clear and fairly self-explanatory. If an elaborate explanation is required the chart or illustration loses its effectiveness.

They must be bold in outline, accurate in detail, not overcrowded. They should be varied and never of one type; the more varied the better, because impressions obtained through one sense become supplemented and rendered more accurate by the aid of those received through another sense.

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OCTOBER ON THE FARM.

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Weather.—Thirteen years ago the largest farmer in a midland county declined to become a member of the proposed agricultural education sub-committee of the County Council on the grounds that weather conditions were the controlling factor in farming, and therefore agricultural science could render little service in practice; moreover, the bailiff who managed one of his farms to his entire satisfaction, could neither read nor write. It is only fair to the councillor in question to state that although he has rarely been known to change his views, his opposition to agricultural education was

short-lived. The fact remains, however, that weather conditions do dominate farming to an extent that is shared by no other industry.

It may be true that the British climate is comparatively very favourable to agriculture; but it was difficult to realise the truth of that contention last autumn, when, owing to persistent wet, seed corn which had been prepared could not be sown, and on many soils no effective attack could be made on the stoloniferous weeds which were overrunning the stubbles. In the vicinity of Derby rain fell on 43 of the 61 days in September and October, giving an excess of 270 tons of water per acre over the average of the previous 20 years. In some of the eastern counties more favourable conditions prevailed, but the effect of the wet autumn on the country as a whole is shown in this year's agricultural statistics by an increase of 107,200 acres of land under bare fallow, and a corresponding reduction in the area of wheat and green crops.

Foreknowledge of what the weather during a season was to be might be helpful, but only to a limited extent. For example, weather students say that a severe winter is about due; if that were a certainty the farmer might decide not to sow wheat later than say 15th November, to put in no winter oats except greys, and not to graze his clovers after the end of October; he might also lay in heavier stocks of dry foods and reserve more straw than usual for foddering; and his clamps of roots and potatoes would be given an additional layer of soil or litter. These, however, are details rather than fundamental changes in practice.

Potato Harvest.—The proper time for lifting and storing the maincrop potatoes is as soon as the tubers have become firm in the skin and easily detachable from the tops. After healthy growth the lifting stage coincides with the decay of the terminal rosettes of leaves, but when the tops have been blighted the appearance of the field may be very misleading and unless due regard is paid to the ripeness of the tubers before pitting heavy loss may be incurred during storage. Unripe potatoes keep badly.

Typically potato lifting is an October operation, and it is in this work and particularly in wet seasons that the advantages of lightish land for potato culture are best realised. The potato plough is used for raising the crop where the acreage grown is small or where the virtues of the modern improved spinner are not fully recognised. On light soil which will fall through the

prongs of the plough, this implement is satisfactory, but elsewhere its use involves excessive labour in gathering the crop, and under current school regulations pickers are not so plentiful as formerly. In the Garforth trials it was found that the machine saved about one-third of the labour required by the plough and bruised really very few tubers.

The work of lifting, whether by fork, plough or spinner, can often be facilitated by horse-hoeing between the drills to bring down some of the mould. With second earlies, which are usually rather weedy, this operation also helps to clean the land. Gathering can also be accelerated by the provision of more suitable receptacles. Probably the best type of basket is the low-sided wide pattern, known in Lancashire as four-score wiskets. They have a handle at each end and are suitable for women or boys working in pairs.

Regarding the storage of the crop, it is essential that the tubers should be ripe, dry, and as free as possible from bruises. Visibly diseased specimens should be picked out. In the pit or clamp, heating and suffocation of the living potatoes must be avoided and provision must be made for the escape of the moisture given off by the tubers during the first few weeks after they are put together. Where the potato crop is followed by spring oats, small, temporary heaps may be made in the field, placed conveniently for emptying the wiskets; these heaps are lightly covered temporarily, as they are later carted to the homestead for more permanent storage; by this time, however, they have completed their " sweat."

The base of a clamp for potatoes should not exceed 4 ft. in width and it need not be dug into the ground; but for convenience in shovelling up the potatoes when being taken out, it should be level and firm. The heap is first covered with a good layer of straw—old thatch does well—but only about 3 or 4 inches of soil are laid on at first; the heavy soiling-over is deferred until the approach of severe weather. To allow of the escape of warm moist air, which if kept in will promote wet rot, the ridge is often left without soil for some weeks or straw ventilators may be inserted in the ridge. With both these devices, there is risk of condensation of the escaping water vapour on its contact with the cold atmosphere, with the result that water drips back into the heap. The better method is that of drawing a pole along under the straw at the ridge during the covering of the heap. The air channel so formed may for a time be left open at both ends.

In illustration of the need for aeration and escape of heat from potatoes during storage the following experience may be mentioned. Two bags of tubers were pitted in the middle of loose potatoes; on opening the pit in March, the tubers inside the bags were found to be wet and rotten whereas the rest of the heap had kept really well.

Mangold Lifting.—Some few years ago many cases of mangolds keeping badly were reported from the eastern counties, and information collected by the agricultural staff at Cambridge showed that bad keeping was in these instances associated with early lifting of the crop during a dry period; crops lifted after the weather had broken kept well. The circumstances were exceptional: as a general rule mangolds keep best when stored early enough to have escaped frost entirely, and as appreciable frost often occurs about the first week in November, it is wise to try and secure the bulk of the crop by that date. On heavy land late lifting may entail difficulties and damage to the soil in carting, and in any case it delays the sowing of the following crop of wheat, which ought to be in the ground before the middle of November. For some obscure reason mangolds in storage do not require so much air as do swedes or potatoes; large heaps may be made without meticulous care as to shape; but sufficient litter-covering must be laid on to keep out frost.

Many farmers throw out mangold tops for consumption by the cattle out at grass; others condemn the practice, holding that mangold leaves contain little nutriment and produce violent scouring. To prevent the latter effect the addition of basic material such as chalk has been suggested in the belief that the cause of scour was acid matter in the leaves. More recent work has, however, indicated that when tops scour the cause is bacterial, and washing the leaves either artificially or by rain prevents the trouble. The food value of tops is nearly equal to that of roots; their manurial value is, however, higher, and this must be taken into account when considering the respective claims of the different parts of the farm.

Wheat after Green Crop.—It is a very common practice to take wheat after potatoes and different methods of preparing the land and sowing the wheat are followed, according to conditions and the farmer's predilection. As the land has been thoroughly and deeply tilled during the cultivation of the potato crop, it is obviously unnecessary to practice deep working in the preparations for wheat. The principal consideration is early and expeditious sowing of the wheat rather than the

observance of a particular routine of operations. Some years ago experiments were carried out at Rothamsted to compare different practices in the sowing of wheat after potatoes; the results in bushels of grain and cwt. of straw per acre were as follows:—

Year	1915		1916		1918	
Date of Sowing	Nov. 6.		Nov. 16.		Nov. 8.	
Variety	S.H.M.		Rivetts.		Standard Red.	
	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.
	bus.	cwt.	bus.	cwt.	bus.	cwt.
Drilled on potato tilth	23.4	20.3	37.9	29.8	—	—
Broadcast and ploughed in	24.6	21.4	40.4	32.1	42.7	42.5
Ploughed and broadcast	25.0	23.4	42.9	35.7	—	—
Ploughed and drilled	24.6	21.1	46.1	43.6	41.9	43.6

Live Stock.—Strong young cattle that have summered satisfactorily usually carry more flesh in October than at any other time of the year: it is natural that they should accumulate reserves to tide over the period of food shortage which winter would naturally incur. Yearlings and older stores should ordinarily require no housing or assistance in fodder until near Christmas. Calves, however, are prone to contract chills, and, on infected land, husk, if left out of doors and not fed artificially. Dry cows at pasture may or may not require additional food, according to whether they have been kept in good condition during their lactation period; but milkers require practically full winter allowances of concentrates. Towards the end of this month the herd may be kept indoors at night; the actual date for night housing, however, varies according to conditions. Experiments conducted at the Harper Adams College some years ago indicated that it was more economical to defer housing till the end of November; on the other hand it is inconvenient to bring the herd up in darkness for morning milking; when gateways become muddy, the difficulties of producing clean milk are increased by each passage of the cows through them; and when nights grow chilly the cattle lie under hedgerows and these spots receive an undue share of manure. Dry, sound land will bear later grazing than wet land, which is seriously injured in such seasons as that of 1924 by grazing too late in the autumn.

Before the herd is housed entirely for the winter, an opportunity should be made to clean the shed down and whitewash it again. When the cows come in for the night, the ventilators should be kept wide open and the shed cool. Newly-calved cows, whether standing in the byre or in a loose box, are advisedly blanketed for a few days.

NOTES ON MANURES FOR OCTOBER.

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THE beginning of the farm year is the best time to decide the scheme of manuring for the coming rotation, for a definite plan prepared in advance enables the farmer to get a view of the expenditure that is to be made on artificials and also to arrange that these shall be on the farm when they will be required. In making his decisions the farmer will have the results of the previous year's operations to guide him, taking into account as far as possible any peculiarities of the season, such as, for example, a serious drought, which may have obscured the action of the manures. In addition to the lessons of local experience and observation certain general considerations will apply.

Soil Conditions.—Good cultivation is the basis of crop production, and only when by proper working the soil has been supplied with air and water, is the land in condition to give the best response to plant food artificially added. Another preliminary factor to be attended to is the chalk supply. If the soil is sour the farmer is confined to a limited number of crops such as potatoes, oats, and rye which can stand a slightly acid condition. The remaining crops do badly and expenditure in fertilisers alone will do little to remedy matters. Moreover, on these soils the choice of artificials is narrowed down to such as are neutral (*e.g.*, bone flour), or supply chalk or other basic substances (*e.g.*, basic slags and rock phosphates), or produce basic substances by their changes in the soil (*e.g.*, nitrate of soda). In order therefore to secure freedom of cropping and of choice of fertilisers it is desirable that the chalking or liming of any sour fields should be attended to.

Soil Requirements.—The manurial requirements of the soil in question will also have to be taken into account. Various laboratory methods have been proposed to determine this, some entirely chemical, such as the citric acid extraction of phosphoric acid and potash, the amounts dissolved by the weak acid solvent under standard conditions being taken as a measure of the availability of these substances to the plant. Another more recent method now being taken up on the Continent depends on the action of the plant itself, the amount of phosphate and potash extracted by seedlings growing in a small sample of the soil in question giving indications of availability.

When the availability of the soil supplies has been determined the need of manurial treatment may be inferred. The final trial for such methods is the extent to which their indications agree with the manurial responses of the same soils under field conditions, and the interpretation of their results is always a matter for a specialist. Hence if the farmer has the results of manurial trials which have been well conducted either on his own farm or on similar land in the locality they will furnish him with the most direct information available. It usually happens that almost all soils, except the very peaty types, such as the black fen land, will respond to nitrogenous manuring; and that light soils stand more in need of potash and less in need of phosphate than the clays.

Crop Requirements.—A further point will be to suit the manuring to the crop requirements. Although all plants remove the same constituents from the land their powers of withdrawing them and the claims made upon the various elements of plant food in the soil is different. Under ordinary conditions experience has shown that nitrogen will be the main requirement of cereal crops, potash of mangolds and potatoes, phosphate of clover, and so forth. It will be good practice therefore to meet the special demand of a crop by suitably arranging the balance of the artificials used.

Dung Supply.—The amount of dung available is another factor which will influence the farmer's requirements of artificials. Dung itself contains all the elements needed by plants, and consequently if a good dressing of farmyard manure is given only such exacting crops as mangolds or potatoes will need artificials in addition, while the residues of dung should be capable of producing a good crop of cereals without further expenditure. In fact, on holdings where the arable area is small and much dung is made with purchased feeding stuffs the need of artificial manures is often reduced to an occasional dressing of phosphate to the root crop. At the other end of the scale are found farms where dung is scarce and roots and cereals will receive complete dressings of artificial fertilisers.

Residues.—It often happens that manures are not entirely used up in the year of application, a residue remaining in the soil for the benefit of the following crop. This is not the case with quick-acting nitrogenous fertilisers, but is commonly observed with slowly-available organic manures such as shoddy and a portion of farmyard manure, and with phosphatic and potassic fertilisers of all types. It occurs when, owing to

accidental causes a crop has failed and therefore has not exploited the plant food it received, or where more manures have been given to a crop than even a large yield could account for. These residues should be borne in mind in making the manurial scheme; for example after roots which have been well done with dung and artificials further treatment for one or possibly for two straw crops will be unnecessary; the phosphates or the potash applied to the nurse crop will come in as residues for the young clover.

Rate of Application.—The aim should be to strike a middle course between obtaining small yields by low consumption of fertilisers and securing heavy yields at too high a price by excessive applications. It is more usual to find cases where too little manure is being used than where the profitable limit of application has been exceeded. The latter case is more likely to be encountered in highly farmed holdings where in the attempt to increase yields that are already large it may happen that the return will not pay for the expenditure on manures. An illustration of the way in which after a certain point each increase in fertiliser application results in less satisfactory returns is provided by the following figures from results of potato experiments carried out at the Midland Agricultural College in the years 1921-23. The potatoes were grown with 12 tons of dung per acre and received in addition applications of a mixture of artificials which was increased from 6 to 16 cwt. per acre. The average results of the three years were :—

Wt. of Artificials. Cwt. per acre.	Potatoes, per acre. Tons.	Cwt.	Increase or Decrease per successive 2 cwt. of Artificial. Cwt. per acre.
6	14	12	—
8	15	8	+ 16
10	15	19	+ 11
12	15	18	- 1
14	15	2	- 16
16	12	8	- 34

It will be noted that serious falling off in the return from the artificials does not occur till over 10 cwt. of manure has been used—a quantity that would be unlikely to be exceeded in ordinary practice.

Purchase of Supplies.—Having estimated the requirements of the farm there will usually be several alternative forms in

which the nitrogenous phosphatic and potassic compounds can be purchased. To make a correct and economical choice requires considerable knowledge of the suitability of fertilisers for the various crops and the soil in question. The system of purchase on the basis of unit price (the cost per unit of most of the common fertilisers is published monthly in this *Journal*) only applies where the alternatives can be substituted for the purpose in view without any marked loss of efficiency. This is not always the case; for example, ground rock phosphate and superphosphate, sulphate of potash and kainit, where the potato crop is in question, are pairs of manures whose purchase could hardly be decided on unit prices alone. On the other hand, when deciding between different grades of similar material, such as 20 per cent. or 30 per cent. potash salts, or 24 per cent. or 28 per cent. basic slag, the unit prices will give a definite guide.

Autumn Dressings.—These will usually be confined to the autumn sown cereals. Nitrogenous applications are rarely given at this time of the year on account of the risk of the washing out of nitrates in wet periods; moreover, since autumn sowing is a feature of farming on the heavy soils rather than on light land where spring seed beds are easier to obtain, the need of potash applications is correspondingly reduced. On the other hand, to promote an early start on late land and to cause the crop to finish well the phosphatic dressings should not be neglected at this season. Superphosphate has the special advantage of being suitable for autumn or spring sowing, but for winter crops an application in the seed bed is then at the disposal of the crop in the early stages of growth. The alternative sources of phosphate such as basic slag or steamed bone flour should likewise be applied before drilling the winter crops. A usual dressing would be about 2 cwt. per acre of superphosphate, or its equivalent in other forms, for cereals and 3 cwt. for leguminous crops. These quantities would be reduced on soils which had received phosphate to the previous crop, and increased with advantage on land which had not recently had a phosphatic application.

Potash manures are likely to be required on the lighter soils, on medium soils when dung has not been given for some years, and on stiffer soils where two or three straw crops have been taken in succession. In these cases from ½ to 1 cwt. per acre of muriate of potash mixed with the above phosphatic dressing would be a suitable addition.

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	*Average Price per ton during week ending Sept. 9th.*				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	13. 2	13. 0	12.10	12.15	16. 5
" " Lime (N. 13 per cent.)	...	12.10	...	...	...
Sulphate of Ammonia, neutral (N. 21.1 per cent.)	12. 7*	12. 7*	12. 7*	12. 7*	(N)11. 8
Kainit (Pot. 20 per cent.)	3. 2	3. 0	...	...	...
" (Pot. 14 per cent.)	2.17	2.15	...	2.15	3.11
Potash Salts (Pot. 30 per cent.)	...	..	...	4. 9	2.11
" " (Pot. 20 per cent.)	...	...	...	3. 2	3. 1
Muriate of Potash (Pot. 50–53½ per cent.) ...	8. 5	7.10	...	9. 2	3. 5
Sulphate of Potash (Pot. 48 per–51½ cent.)...	12.10	11.15	...	11. 0	4. 4
Basic Slag (T.P. 34 per cent.)	...	...	3. 0§	...	...
" " (T.P. 30 per cent.)	3. 3§	...	..	2.15§	1.10
" " (T.P. 28 per cent.)	2.10§	2. 5§	...	2.10§	1. 9
" " (T.P. 26 per cent.)	2. 6§	2. 1§	...	2. 5§	1. 9
" " (T.P. 24 per cent.)	...	1.17§	1.18§	...	...
Superphosphate (S.P. 35 per cent.)	...	...	...	3. 6	1.11
" (S.P. 30 per cent.)	...	2.17	...	3. 0	2. 0
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	8.15	8. 5	7.17	8. 0	...
Steamed Bone Flour (N. ¾, T.P. 60-65 per cent.)	6. 2†	6.10†	6. 5	5.10	...
Fish Guano (N. 7½-8½, T.P. 16-20 per cent.)	...	...	13. 0	...	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

§ Prices include cost of carriage from works to town named. Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire and London prices are for not less than 4-ton lots delivered within a limited area. Cost to purchasers in other districts will be greater or less according to the distances of different purchasers from the works.

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MONTHLY NOTES ON FEEDING STUFFS.

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Maize By-products.—Maize is used in many commercial processes, and the by-products resulting from these processes find their way on to the market as stock feeds. Thus maize is used in the brewing and distillery trades, and is also used for the production of maize starch, which is more commonly known as "cornflour." For preparation for the brewing and distillery trades, the whole maize is treated with a degerminator, which removes the germ or embryo, together with part of the hull and some of the starch. The degerminated grain is then treated by a steaming and rolling process, which converts it into "brewery

flakes." The residue thus obtained forms maize germ meal, which, as indicated above, consists of the germs together with some hulls and starch. Owing to the commercial value attached to maize oil, this maize germ meal often undergoes an oil extraction process, such oil-extracted maize germ meal being known, according to Burtt-Davy, as corn oil cake.

In the production of cornflour by the wet extraction process, the maize germs are floated off and dried, and this product, consisting practically of pure maize germs, is also known as maize germ meal. As a result, maize germ meal can vary considerably in composition. Thus a maize germ meal derived from the first process, will give an analysis of 5 to 7 per cent. of oil and 10 to 11 per cent. of albuminoids, whereas a maize germ meal obtained in the preparation of "cornflour" by the wet process will give an analysis of 11 per cent. oil and 21 per cent. of albuminoids. In buying maize germ meal it is therefore very necessary to study closely the analysis given with it. Flaked maize itself, which is said to be made from the whole maize (the process consists in steam cooking followed by a rolling process which converts the grain into yellow, attractive-looking flakes) also varies in composition, some samples containing about 2 per cent. of oil whereas others contain nearly 5 per cent.

Sufficient has been said to emphasise the necessity of caution in buying maize by-products, owing to variability in composition of these products. It will complete the story if brief mention is made of the various by-products that are on the market.

(1) *The Whole Grain.*—This consists of hull or bran, a highly nitrogenous and oily germ, horny starch and ordinary starch.

(2) *Flaked Maize* consists of the whole grain treated to form attractive-looking flakes. Flaked maize is sold under various trade names, and should resemble in analysis the whole maize. Is often low in oil.

(3) *Maize Gluten Feed*, which consists of the whole of the by-products obtained in the manufacture of maize starch, *i.e.*, consists of whole grain less the starch. It is a highly nitrogenous and oily feeding stuff.

(4) *Maize Germ Meal*, consisting of maize germs. In some samples contains some hulls and also starch, and is therefore variable in composition.

(5) *Maize Grits* consists of horny starch, and is therefore a starchy food.

(6) *Maize Gluten Meal.*—This differs in analysis from maize gluten feed and is quite a different by-product.

DESCRIPTION.	Price per Qr. s. d.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv. s.	Price per lb. Starch Equiv. d.	Per cent of Digest. Crude Protein %.
Wheat, British	—	—	11 15	0 14	11 1	71·6	3/1	1·65	10·2
Barley, British Feeding	—	—	10 15	0 11	10 4	71	2/10	1·52	6·5
" Canadian :—									
" No. 3 Western	41/0	400	11 10	0 11	10 19	71	3/1	1·65	6·5
" " 4 "	37/9	"	10 11‡	0 11	10 0	71	2/10	1·52	6·5
" American	36/0	"	10 2†	0 11	9 11	71	2/8	1·48	6·5
" Karachi	40/6	"	11 7	0 11	10 16	71	3/1	1·65	6·5
" Tunisian	34/9	"	9 15‡	0 11	9 4	71	2/7	1·38	6·5
Oats, English, White	—	—	10 7	0 12	9 15	59·5	3/3	1·74	8·0
" " Black and Grey	—	—	9 13	0 12	9 1	59·5	3/1	1·65	8·0
" Canadian :—		—							
No. 2 Western	33/6	320	11 14	0 12	11 2	59·5	3/9	2·01	8·0
" 3 "	29/6	"	10 6*	0 12	9 14	59·5	3/3	1·74	8·0
" Feed	27/0	"	9 0	0 12	8 17	59·5	3/0	1·61	8·0
" American	25/9	"	9 0	0 12	8 8	59·5	2/10	1·52	8·0
" Argentine	27/9	"	9 14	0 12	9 2	59·5	3/1	1·65	8·0
" Chilian	27/6	"	9 12*	0 12	9 0	59·5	3/0	1·61	8·0
Maize, Argentine	45/6	480	10 12	0 12	10 0	81	2/6	1·34	7·1
Beans, English Winter	—	—	12 0†	1 9	10 11	67	3/2	1·70	20·1
" Chinese "	—	—	11 2*	1 9	9 13	67	2/11	1·56	20·1
Peas, Japanese	—	—	26 5*	1 5	25 0	69	7/3	3·88	19·4
Dari, Egyptian	—	—	12 0	0 14	11 6	75·2	3/0	1·61	7·7
Millers' Offals :—		—							
Bran, British	—		7 2	1 4	5 18	45	2/7	1·38	10·9
" Broad	—	—	8 10	1 4	7 6	45	3/3	1·74	10·9
Middlings—		—							
Fine Imported	—		9 10	1 0	8 10	72	2/4	1·25	12·6
Coarse, British	—	—	8 2	1 0	7 2	64	2/3	1·20	11·5
Pollards, Imported	—	—	7 5	1 4	6 1	60	2/0	1·07	11·6
Meal, Barley	—	—	12 2	0 11	11 11	71	3/3	1·74	6·5
" Maize	—	—	12 5	0 12	11 13	81	2/11	1·56	7·1
" " South African	—	—	10 5	0 12	9 13	81	2/5	1·29	7·1
" " Germ	—	—	10 5	0 17	9 8	85·3	2/2	1·16	18·4
" " Gluten Feed	—	—	10 0	1 5	8 15	75·6	2/4	1·25	20·0
" Locust Bean	—	—	9 17	0 8	9 9	71·4	2/6	1·34	4·0
" Bean	—	—	13 0	1 9	11 11	67	3/1	1·65	20·1
" Fish	—	—	20 10	3 17	16 13	53	6/3	3·35	50·0
Linseed	—	—	21 7	1 8	19 19	119	3/4	1·78	19·4
" Cake, English		—							
12% Oil	—		14 5	1 15	12 10	74	3/5	1·83	25·3
" " 10% Oil	—	—	14 2	1 15	12 7	74	3/4	1·78	25·3
" " 9% Oil	—	—	13 12	1 15	11 17	74	3/2	1·70	25·3
Soya Bean " 6 % Oil	—	—	12 10	2 8	11 2	69	3/3	1·74	38·2
Cottonseed Cake, English		—							
5½% Oil	—		8 15	1 12	7 3	42	3/5	1·83	17·6
" " Egyptian		—							
5½% Oil	—		8 5	1 12	6 13	42	3/2	1·70	17·6
Decorticated Cotton		—							
Seed Cake 8% Oil	—		12 15†	2 9	10 6	71	2/11	1·56	34·6
" " Meal 7½% Oil	—	—	12 5*	2 9	9 16	74	2/8	1·43	36.3
Ground Nut Cake 7% Oil	—	—	11 0†	1 13	9 7	56·8	3/3	1·74	27·7
Decorticated Ground		—							
Nut Cake 7% Oil	—		12 15‡	2 10	10 5	73	2/10	1·52	42·0
Palm Kernel Cake 6% Oil	—	—	9 0	1 1	7 19	75	2/1	1·12	17·1
" " Meal 2% Oil	—	—	8 0	1 2	6 18	71·3	1/11	1·03	17·1
Feeding Treacle	—	—	7 2	0 8	6 14	51	2/8	1·43	1·1
Brewers' Grains :—		—							
Dried Ale	—		8 12	1 2	7 10	49	3/1	1·65	14·0
" Porter	—	—	8 5	1 2	7 3	49	2/11	1·56	14·0
Wet Ale	—	—	1 2	0 8	0 14	15	–/11	0·49	4·8
" Porter	—	—	0 18	0 8	0 10	15	–/8	0·36	4·8
Malt Culms	—	—	8 10*	1 11	6 19	43	3/3	1·74	1·9

* At Liverpool. † At Bristol ‡ At Hull

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of August and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 3s. per ton. The food value per ton is therefore £8 17s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices:—N, 11s. 7d; P_2O_5, 3s. 7d.; K_2O, 2s. 9d.

(7) *Maize Bran* consists of the hulls of the maize and contains 12 per cent. of crude fibre, and is low in protein.

(8) *Hominy Feed.*—This contains the hulls, germs and starchy refuse which arise as the by-product in the manufacture of hominy.

(9) *Maize Distiller's Grains*, which consists of the dried grains resulting from the maize used in the distillery. It contains 12 per cent. of crude fibre.

Grit in Poultry Mixtures.—Poultry mixtures often, though not always, contain an admixture of grit. It is highly desirable that purchasers of poultry mixtures should ascertain, if possible, the amount of grit present, since it is not always easy to detect. Grit is a comparatively cheap material compared with the other ingredients of a poultry mixture, and a temptation always exists, where grit is included in a mixture, to include a larger percentage of grit than the purchaser might desire or than is compatible with the price. Experiment has shown that although grit is a useful accessory to digestion in fowls, it is not an essential adjunct to poultry foods, since fowls may be maintained in perfect health under grit-free conditions. Moreover, in the absence of grit, the grit already present in the gizzard is retained for long periods. On the assumption that the gizzard of the fowl contains $\frac{1}{2}$ to $\frac{3}{4}$ oz. of grit, a poultry mixture containing 1 per cent. of grit will supply all the bird requires in a month, and this amount will be replaced by a similar amount every month that the bird is kept on this mixture. It would seem, therefore, unnecessary for poultry mixtures to contain more than 1 per cent. of added grit, and poultry mixtures containing 5, 10, 20 and sometimes nearly 40 per cent. of grit would certainly appear to be overloaded with this material.

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FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat	1·34	2 6	71·6	8 19	0 14	9 13
Oats	1·34	2 6	59·5	7 9	0 12	8 1
Barley	1·34	2 6	71·0	8 18	0 11	9 9
Potatoes	1·34	2 6	18·0	2 5	0 3	2 8
Swedes	1·34	2 6	7·0	0 17	0 2	0 19
Mangolds	1·34	2 6	6·0	0 15	0 2	0 17
Beans	1·34	2 6	67·0	8 7	1 9	9 16
Good Meadow Hay	1·65	3 1	31·0	4 16	0 13	5 9
Good Oat Straw	1·65	3 1	17·0	2 12	0 7	2 19
Good Clover Hay	1·65	3 1	32·0	4 19	0 19	5 18
Vetch and Oat Silage	1·47	2 9	14·0	1 18	0 7	2 5
Barley Straw	1·65	3 1	19·5	3 0	0 6	3 6
Wheat Straw	1·65	3 1	11·0	1 14	0 4	1 18
Bean Straw	1·65	3 1	19·0	2 19	0 9	3 8

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MISCELLANEOUS NOTES.

The Potato and its Origin.

IT is generally accepted without question that the potato was first introduced into Europe by Sir Walter Raleigh. There is a pretty story, too, how his gardener—to whom the tubers were given for experiment—disgusted by the sour fruit which in due time appeared, gladly obeyed his master's order to dig the plants up, only to discover, with surprise, that where he had planted one tuber there were now several. It is recorded, too, that early in the last century, when Sir Walter Scott was presented with the freedom of Cork he declared that "The discovery of that root (the potato) is alone sufficient to immortalise the hero who lost his head so unjustly on Tower Hill." These and other legends are now shattered by a series of articles by W. E. Safford in the American "Journal of Heredity,"* entitled "The Potato of Romance and Reality." It now appears that "there is not a particle of evidence that Sir Walter ever saw a potato in America." In Germany, it is Sir Francis Drake who figures as the legendary discoverer of the potato. In Offenburg (Baden) there is even an imposing statue in his honour, on which the great navigator appears holding in his hand a potato plant with the tubers attached. The Drake legend, however, has no better foundation than that which associates Raleigh with what is sometimes popularly styled "the comestible tuber."

* Vol. XVI, No. 4, April, 1925, pp. 113-126; No. 5, May, 1925, pp. 175-184; and No. 6, June, 1925, pp. 217-230.

The true story of the potato as established by recent American research is, shortly, as follows:—The potato, as we know it, was in cultivation in South America centuries before the Christian Era. Persistent search has failed to find *Solanum tuberosum* growing as a wild plant. Vases discovered in prehistoric graves in Columbia have the exact shape of the cultivated plant, and even in some cases dried specimens of the root have been found in these tombs. When the Spaniards first invaded South America they found the potato extensively cultivated in the higher parts of the country now known as Columbia. As early as 1538, an early Spanish writer speaks of the potato found growing near Quito as " a kind of groundnut, which when boiled becomes as soft as a cooked chestnut." It was known in the native languages as " papas," a word from which our English word " potato " is probably derived. The Spaniards appear to have taken some of the tubers to Europe soon after their conquest of Peru, for we know that the potato was in cultivation in Italy as early as the year 1585. For a century afterwards it appears to have been grown in gardens both in England and the Continent, but merely as an interesting exotic plant.

Now comes an interesting fact. The value of the potato as a food staple was first recognised in Ireland, where soon after its introduction in the seventeenth century it became the main food crop of the poorer classes. In 1664 in England the first pamphlet advocating the cultivation of the potato appeared under the curious title, " England's Happiness Increased, or a Sure and Easy Remedy Against all succeeding Dear Years by a Plantation of the Roots called Potatoes, etc., etc., Invented and Published by John Forster, Gent., of Harslop in Buckinghamshire." Apparently the first county in England to adopt the cultivation of the potato extensively was Lancashire, but as late as 1770 it was not grown as a farm crop in the southwest of England.

The cultivation of the potato in Germany dates from 1774, when Frederick the Great set himself the task of imposing its use on his people. It was some years later that the cultivation was introduced into France under Louis XVI, largely as a consequence of the publicity given to its merits by one Parmentier, an obscure pharmacist, who had learned to appreciate the potato when a prisoner-of-war in Germany.

Such, in brief, are some of the facts picturesquely narrated in the articles quoted.

The Drying of Wheat.

IN regard to wheat-growing it is well to recognise some of the disabilities under which the British farmer suffers in comparison with his foreign competitors. Before wheat can be milled, it is necessary that it should be brought to a regular content of moisture by a process called "tempering" or "conditioning."

The grain is washed and dried, whereby it may lose weight, if there was a large percentage of moisture originally present. Dry grain, on the other hand, absorbs moisture in the process. As an instance of what happens: a milling test made a little time ago for the purpose of comparing Canadian and Home-Grown wheat showed that Manitoba No. 1 wheat before conditioning contained 13 per cent. of moisture and Home-Grown wheat 19 per cent. After conditioning, the Manitoba wheat contained 16.8 per cent., a gain of 3.8 per cent., and Home-Grown wheat 16 per cent., a loss of 3 per cent. On the average, Imported wheats contain about 10 to 15 per cent. of moisture, whilst Home-Grown wheats at harvest may contain as much as 15 to 22 per cent. in an ordinary season, and more in a wet season. This constitutes a great handicap in getting a good price for English wheat immediately after harvest, especially as millers are not always in a position to deal with large bulks of damp wheat.

The newer English wheats, *e.g.*, Yeoman, are little, if at all, inferior to the best imported sorts in everything but moisture content, and they should, when conditioned, command similar prices, but they suffer in the same way as do ordinary English wheats in a wet season. Many farmers, of course, do their best to condition their wheat in stack before sale and try to spread their sales over a longer period. To assist their object, good stacking and thatching of ricks are of the first importance: and the grain can be further improved after thrashing by spreading it on a dry floor exposed to a strong draught and turning it frequently.

In a season like the present, it is specially important that the farmer should not attempt to force early sales of wheat while it is still in poor condition. The result must be to depress the price of English wheat to a point below its proper parity with foreign wheat, as has often been the case in recent autumns.

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Stud Goat Scheme, 1925-6.

THE object of this Scheme is to improve, by means of breeding, the productive quality of the milch goats kept by smallholders, cottagers, and others of similar standing. Eighty-eight stud goats at various centres throughout the country have been approved and registered for the current breeding season which began on the 1st September, and their services are available for goats owned by smallholders, etc., at a nominal fee, in no case exceeding 5s. Conditions of service and other particulars may be obtained from the County Agricultural Organisers at their respective County Education Offices, or from the Honorary Secretary of the British Goat Society, which is responsible for the administration of the Scheme, at 10, Lloyd's Avenue, London, E.C.3.

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Improved Poultry Keeping on the Farm.

IT is estimated that 60 per cent. of the eggs consumed in Great Britain are home produced and the remaining 40 per cent. are imported, at a cost to the consumers last year of nearly £14,000,000. One may pass through miles of farm land by road or by rail in some districts without seeing a single fowl, and yet eggs and poultry can be produced more economically by the farmer, and by many fruitgrowers, than by the specialist poultry farmer. All the eggs and poultry required by the population of the British Isles could, without doubt, be produced upon the general farms and in fruit orchards, without the displacement of any other stock, or the sacrifice of any part of the crops now grown.

The value of poultry on the land is frequently overlooked. Considerable evidence is available of their use in the destruction of insect pests. The wire worm, probably the greatest insect enemy with which the farmer has to contend, is one of the many pests which poultry will devour greedily. Fowls will follow the plough seeking these and other harmful insects, and will range the meadows and arable land in all seasons to secure food of this nature. In the course of their wanderings over the land they distribute manure of a highly nitrogenous nature. Where poultry are kept about the farmyards and buildings, the manure is worse than useless and the destruction of insect life is of little consequence, but if modern methods of poultry-keeping are practised, the fowls are scattered over the

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farm, where they glean a substantial portion of their own living and at the same time benefit the land.

For most farms of from 100 acres upwards, the following is a system which has been found successful. The breeding stock is composed of hens carefully selected from the pullet flocks after their first full moult. These special hens are mated to cocks or cockerels from pedigree layers which are purchased from specialist breeders and renewed every second year. Only one breed is kept. It is a great advantage to concentrate upon one breed and to build up a good strain. The breeding stock need not be penned and will thrive better when kept upon free range. The number of the breeding stock is determined by the extent of the operations and everything is designed to secure the object in view, whether that be to rear laying pullets or produce table poultry. The number of chickens required is estimated, and adequate provision is made for hatching and rearing this number up to the stage when the pullets will be transferred to laying sheds and the cockerels become fit for market.

The breeding flocks are kept in portable houses, either in single flocks of 12 hens and a cock, or multiple flocks of 30 hens with two or three cocks. These birds have free range, and when in such small numbers can be placed upon almost any spot on the farm without damage to growing crops. The stock under these conditions are vigorous and hardy. The laying stock, in flocks of from 50 to 150 in a shed, are located at suitable spots on the farm. Generally a pen of $\frac{1}{4}$ to $\frac{1}{2}$ an acre in extent is attached to the house. The pen is only used at seasons when it is necessary to keep the birds under control, and an odd corner of a field can be chosen for the purpose. A flock is often placed on a meadow used for grazing, when a pen is unnecessary.

For rearing the chickens a sheltered meadow, an orchard, or rough ground near the homestead, is selected, and it is a great advantage to change the rearing ground each year. Portable hovers are used in small chicken houses for incubator-hatched chicks. These houses are easily moved and are suitable, without the hover, for rearing young stock up to the adult stage, or for a hen with a large brood of chicks instead of a coop. To provide the additional accommodation necessary for the young birds as they grow, Sussex Night Arks are most suitable, but in many cases rough temporary shelters can be erected.

The labour in connection with the poultry is frequently a difficulty. When operations are upon a large scale, the employment of an experienced poultryman is justified. The wage of a poultryman is usually higher than that of other farm workmen, but the hours are long and the work arduous. Where, however, the farmer possesses up-to-date knowledge of poultry management, less expensive labour can be engaged. Many young men and women are interested in this work, and such employees devoting their whole time to poultry can be expected to look after not less than 500 head of permanent stock and to rear 1,000 head of chickens annually each.

The work must be systematic and so arranged as to save unnecessary labour. Laying sheds at a distance should have corn and meal bins on the spot, water can be caught off the roof of the shed into a butt; these and similar labour-saving devices prove an economy. The capital expenditure entailed and the absence of a complete and methodical system have hitherto prevented the rapid extension of farm poultry-keeping, but an efficient plant can be built up gradually without a heavy initial outlay. The rent of many farms is paid by the profits from poultry, but on other farms money is lost and valuable opportunities are wasted through careless management and ignorance.

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Solubility of Phosphatic Manures in Citric Acid Solution.

THE Ministry has noticed in recent years cases in which sellers of phosphatic fertilisers have stated the percentage of phosphate soluble in a solution of citric acid by methods different from those prescribed by the Ministry under Section 1 of the Fertilisers and Feeding Stuffs Act, 1906.

Regulation 3 of the Fertilisers and Feeding Stuffs (General) Regulations, 1908, provides that 500 cubic centimetres of a 2 per cent. solution of citric acid shall be used with 5 grammes of the fertiliser, the whole being continuously agitated for 30 minutes. If, however, the seller gives the solubility obtained, for example, by using 5,000 c.c. of the solvent and agitating for two hours the percentage of phosphates shown will be greater than that which would be found by the official method, and the farmer will be misled in comparing one fertiliser with another.

The Ministry, therefore, desires to call the attention of farmers to the fact that the results of analyses for citric

solubility vary according to the method used, and that consequently in comparing two fertilisers the buyer should make sure that the solubility shown in the statement accompanying the fertiliser has been ascertained by the same method in both cases. A letter has been addressed by the Ministry to all county authorities for agricultural education, asking that their technical staffs may also direct farmers' attention to the matter.

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Horticultural Education Association.

THE Annual Meeting and Conference of the Horticultural Education Association was held at the University College, Reading, on the 9th and 10th September. This Association, whose object is the development of horticultural education, was formed in the year 1904, on the initiation of the late Mr. Brooke Hunt, an Inspector of the Board of Agriculture, when about twelve enthusiastic horticulturists were enrolled. Five times that number, out of a total membership of approximately 180, attended on the occasion of the recent Conference. The party assembled on the morning of the 9th, and was conducted through the College buildings. The afternoon was spent at the College Horticultural Station, Shinfield, which covers an area of 45 acres of fruit, vegetables and flowers. Mr. Cobb, who is in charge of the Centre, explained some of the trials and experiments in progress. The working of a small motor-driven cultivator, a hedge-trimming appliance, and a new process of seaming fruit preserving cans, was demonstrated.

Later in the afternoon, Mr. Lobjoit, the Controller of Horticulture to the Ministry, gave an address on "The Ministry's views of Horticultural Education." Referring to an exhortation he had made at a previous annual conference of the Association, when he stressed the need for County Horticultural Officers to lay themselves out to afford assistance to commercial growers, Mr. Lobjoit said that he was glad to know of the growing volume of appreciation of the services provided and the growers' increased confidence in those by whom such services were rendered. The continued maintenance and expansion of the organisation of County Advisory Officers must be mainly determined by the attitude towards them adopted by the industry concerned. There should, however, be thought for and sympathy with the little

units—the allotment holders waging an uneven combat in adverse conditions, struggling to produce food for man's body and beauty for his refinement, from parallelograms of earth fronted and backed by buildings and flanked by fences! The Controller then alluded to the fundamental alteration in the character and status of the allotment which the Act of 1925 had effected, and pointed out that even the allotment was no longer a purely domestic matter but may now be also a business. He suggested that it might be an opportune moment for encouraging the growth of certain vegetables which a good gardener can produce, but which the average household could not afford to purchase. In addition, space should be given to certain kinds of fruit and flowers.

On the following day the members were motored out to Messrs. Sutton's trial grounds at Reading and Slough, and were conducted round the trials and subsequently entertained to luncheon by Messrs. Phillip and Noel Sutton. From there the party proceeded to Uxbridge to visit the extensive flower and bulb establishment of Messrs. Lowe and Shawyer.

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Hops.

THE control of hops ceased on 15th August. There is now a duty of £4 per cwt. on hops imported from foreign countries and of £2 13s. 4d. per cwt. on hops imported from Empire countries.

The period of control having ended, the market returns to more normal conditions of trading. It is understood that the advisory committee which has taken over the responsibility of dealing with the surplus of the 1924 English crop has decided to make no alteration either in policy or prices for the moment. The growers' scheme for the collective selling of the 1925 English crop, and those of the four succeeding years, is meeting with general approval among growers, but no definite information as to whether it has received the support necessary to make its existence possible under the proposed conditions is yet available.

The area of hops in England and Wales this year is 26,200 acres, an increase of 300 acres on that of last year, but 12,300 acres less than the average of the ten years immediately preceding the war. On 1st August the yield per acre was expected to be under average, so that the total production is

likely to be considerably smaller than the 444,000 cwt. picked last year, when yields per acre were 3 cwt. above the previous maximum. Some 100,000 cwt. were still unsold by the Hop Control on 15th August.

The quantity of hops produced in this country forms a very appreciable proportion of the total world production. In the five years 1919 to 1923 the average total production in England, Canada, Australia, New Zealand, United States, Austria, Belgium, Czecho-Slovakia, France, Germany, Hungary, Poland and Serbia amounted to 813,000 cwt., of which 245,000 cwt., or 30 per cent., were grown in England and 241,000 cwt. in the United States, practically all the remainder being produced in European countries, of which Czecho-Slovakia, Germany and France are by far the largest producers. Canada, Australia and New Zealand grew only 6,700 cwt., 19,400 cwt. and 7,300 cwt. respectively. In 1924 the production in the northern hemisphere was 1,218,000 cwt., of which England picked 444,000 cwt., or 36 per cent., and the United States 226,000 cwt., or 19 per cent.

The average imports of hops into the United Kingdom in the five years 1909-1913 amounted to 198,600 cwt., of which 108,000 cwt. came from the United States, 46,000 cwt. from Germany and 23,000 cwt. from Belgium. In 1923 only 13,500 cwt. were imported, and in 1924, 95,000 cwt., whilst in the seven months January to July of this year imports have been 68,600 cwt.

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Clean Milk Course for Sanitary Inspectors.

EARLIER in the year a meeting of the Sanitary Inspectors' Association, which was addressed by the Ministry's Dairy Commissioner, unanimously agreed that Sanitary Inspectors should attend a Clean Milk Course such as is held at Reading annually, in order that they might gain, first hand, a knowledge of the important factors in clean milk production. It was thought, however, that very short courses should be held. Subsequently, six provincial institutions agreed to make the necessary arrangements, and the first of these courses has already been held at Leeds University from 8th to 16th July. The instruction at this course was focussed upon showing and explaining the methods and things that really influence the results obtained in clean milk production. By

means of class room and laboratory work, visits to local farms and dairies, followed by a discussion of the conditions found at these centres in respect to the improvements (if any) necessary for the production and handling of clean, wholesome milk, it was convincingly demonstrated that methods rather than premises and equipment have the greatest influence on the purity of the milk yielded in any cowshed or handled in any dairy.

The course was attended by 16 persons, most of whom were Chief Sanitary Inspectors, and satisfaction with the course was expressed.

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Farm Workers' Minimum Wages.

A MEETING of the Agricultural Wages Board was held on 1st September at 7, Whitehall Place, S.W.1, the Chairman, Lord Kenyon, presiding.

The Board made an Order giving effect to a resolution received from the Pembroke and Cardigan Agricultural Wages Committee, fixing minimum rates of wages and overtime rates for all classes of male and female workers in their area, to come into operation on 1st October, 1925 (when the existing rates are due to expire), and to continue up to 30th September, 1926. The new rates for male workers show general increases on those at present in operation, the minimum rates in case of workers aged 21 and over being increased from 30s. to 31s. (per week of 50 hours in winter and 54 hours in summer), and the overtime rates for such workers being increased on weekdays from 8d. to 8½d. per hour, and on Sundays from 9d. to 9½d. per hour for the first three hours of employment, and from 10½d. to 11d. for subsequent hours. The rates for female workers remain unchanged, the rate for workers aged 18 and over being 5d. an hour for a day of 8 hours with overtime on weekdays at 6d. per hour, and on Sundays at 6½d. for the first three hours and 7½d. for subsequent hours.

Copies of the Order in full can be obtained on application to the Secretary of the Agricultural Wages Board.

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The Allotments Act, 1925.*

THE Ministry has drawn the attention of Councils of urban areas to the provisions of the Allotments Act, 1925, which received the Royal Assent on 7th August. The new Act introduces several new features in the law relating to allotments, in addition to making certain minor modifications in the Act of 1922.

Section 2 empowers the Public Works Loan Commissioners to advance money to approved Societies for the purpose of purchasing land for allotments. While this section does not directly concern local authorities, its operation within their respective areas will doubtless be watched with interest. It should be observed that this extension of the facilities for obtaining allotments without the intervention of allotment authorities does not in any way diminish the statutory responsibility of those authorities for the provision of allotments.

Section 3 requires Town Planning Authorities to consider, in connection with the preparation of town planning schemes, what provision ought to be included therein for the reservation of land for allotments, and to consult with and consider any recommendations made by the Council of any Borough or Urban District any part of whose district is within the area of a proposed scheme. Every such Council is required to take into consideration from time to time, and at least once a year, the question whether any and if so what lands within the area of the scheme are needed for allotments whether reserved for the purpose or not, and ought to be acquired under and in accordance with the provisions of the Allotments Acts, 1908 to 1925.

In the case of any Borough or Urban District for which an Allotments Committee is appointed under the Allotments Act, 1922, as amended by the Act of 1925 (see Section 12 *post*) any matter which the Council is required to consider under this section is to be referred in the first instance to the Allotments Committee.

Section 4 enables the Council of a Borough or Urban District to take proceedings under the Allotments Acts if, in the opinion of the Council, the expenses incurred under the provisions of those Acts (other than the expenses mentioned in Section 16 (2) of the Act of 1922) may reasonably be expected after the proceedings are taken to exceed the receipts by no greater amount than would be produced by a rate of 1d. in the £. This inaugurates a departure from the principle laid down by previous Acts that allotment schemes should be planned on a self-supporting basis. The new provisions should prove of value in cases where Councils have been prevented hitherto from acquiring land for allotments solely by reason of the impossibility of recouping the whole of the expenditure out of the rents.

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* Copies of the new Act (15 & 16 Geo. 5, c. 61) may be obtained either direct or through any bookseller, from H.M. Stationery Office, at the following addresses: Adastral House, Kingsway, London, W.C.2, and 28, Abingdon Street, London, S.W.1; 37, Peter Street, Manchester; 1, St. Andrew's Crescent, Cardiff. Price 3d. net, exclusive of postage.

A Memorandum will also be available shortly through the same channels, price 1d. net, indicating the modifications which are necessary in the Ministry's Memorandum setting out the provisions of the Act of 1922, consequent upon the passing of the new Act.

Section 5 expressly empowers the Council of a Borough or Urban District to acquire land for allotments in advance of actual needs, provided the Minister of Health is satisfied after consultation with the Minister of Agriculture and Fisheries that there is a reasonable expectation that the land will eventually be required for that purpose. This section, coupled with Section 4, should be of material benefit in rapidly growing districts where land is appreciating in value and can be acquired on more advantageous terms than will be possible when development is more advanced and the demand for allotments more urgent.

Sections 6 *and* 7 relate to "unoccupied" land entered upon by Councils of Boroughs and Urban Districts under Section 10 of the Act of 1922. *Section* 6 extends from two months to three months the period of notice that the owner of such land must give of his intention to resume possession of the land for some purpose other than its use for agriculture, sport or recreation, and from two months to six months the period of notice to be given where the land is required for use for sport or recreation. There is a reservation in the latter case that the notice is to expire on or before the 6th April or on or after the 29th September.

Section 7 amends the compensation provisions of Section 10 of the Act of 1922 by providing that, notwithstanding any agreement to the contrary, the tenant of an allotment garden provided on land entered upon under that section, shall be entitled to compensation in accordance with the Act of 1922 if the rent of the allotment garden exceeds 3d. a pole, unless in the case of a tenancy existing on the 7th August, 1925, the Council within three months from that date give notice in writing to the tenant that the rent of the land is, as from the last preceding date for payment of rent, reduced to a rent of 3d. per pole or less. The effect of this is that Councils providing allotment gardens by entry under Section 10 will no longer be able to contract out of payment of compensation (as they were empowered to do under Section 10 (4) of the Act of 1922) if the rent of such allotments exceeds 3d. per pole. It will be borne in mind that compensation payable to an owner of land occupied under Section 10 is limited to the rent that a tenant might reasonably be expected to pay for the land in its condition at the time of entry. If therefore a Council elects to charge the allotment holders more than 3d. a pole and to pay them compensation in the event of their being dispossessed between 6th April and 29th September through the Council having to give up the land, there should be a margin out of which such compensation can be paid after discharging any claim by the owner for loss due to the Council's occupation of his land.

Section 8 of the new Act provides that a local authority having once purchased land for allotments shall not sell, appropriate, use or dispose of the land for any other purpose without the consent of the Minister of Agriculture and Fisheries after consultation with the Minister of Health. Such consent is not to be given unless the Minister of Agriculture and Fisheries is satisfied that adequate provision will be made for allotment holders displaced by the action of the local authority, or that such provision is unnecessary or not reasonably practicable.

This new provision is supplementary to Section 32 of the Small Holdings and Allotments Act, 1908, and Section 22 of the Land Settlement (Facilities) Act, 1919. It should be carefully noted than Section 8 confers no new powers of sale, appropriation or disposal. Such powers, in so far as they are not otherwise provided, will still depend on the

Acts of 1908 and 1919, but with these modifications: (*a*) the consent of the Minister under the new Act will render unnecessary that of the County Council under Section 32 of the Act of 1908, and (*b*) such consent will be necessary in future in the case of County Boroughs which were excluded from the provisions of Section 32 by Section 37 of the Act of 1908.

It is also desirable to make it clear, (*a*) that in the case of land being appropriated under the provisions of Section 22 of the Land Settlement (Facilities) Act, 1919, the consent of the Minster of Health as well as the Minister of Agriculture and Fisheries will continue to be necessary and should be applied for concurrently, and, (*b*) that the proceeds of any sale of land under Section 32 of the Act of 1908 will continue to be dealt with in acordance with Sub-section (2) of that section.

Section 9 extends from 10 to 21 days the time within which a local authority or allotments association, by notice served on a landlord proposing to resume possession of land let by him for allotments or entered upon by the Council under Section 10 of the Act of 1922, may require the question as to whether such resumption is required in good faith to be determined by arbitration. This will allow more time for a Council or an association to consider whether the facts justify a reference to arbitration. It is frequently alleged on behalf of allotment holders that land used for allotments subject to the right of the owner to regain possession for building or other specified purposes is sometimes given up without due reason and left idle for a long period. While the occurrence of such cases does not necessarily afford evidence of bad faith on the part of the landlord, it does appear to make it desirable that Councils occupying land of this description should be at some pains to satisfy themselves, before giving up the land, that there is adequate evidence of the landlord's intention and ability to use it, and they should not overlook their power under Section 11 (2) of the Act of 1922 as now amended, to contest suitable cases.

Section 10 provides that the assessment for rates of land brought into use for allotments for the first time after 7th August, 1925, shall not be increased during the first three years of such use. The section also provides for cases where an apportionment is necessary as between the allotment land and other land that may previously have been included with it in one assessment.

Section 11 also deals with rating, and provides that where land is let for allotments to an approved society as defined in Sub-section 2 (8), the society may by notice to the rating authority require that it shall be rated as if it were the actual occupier of the land. Previously the position was that the rating authority could at its discretion assess either the society or the individual allotment holders, but Section 17 (2) of the Act of 1922 which gave the discretion is now repealed.

Section 12 requires the Council of any Borough or Urban District that has provided more than 400 allotments to set up an allotments committee unless exempted by the Minister, notwithstanding that the population of the Borough or Urban District is less than 10,000. The Act of 1922 already provides for such committees to be set up in cases where the population exceeds that figure.

Sub-section (2) slightly increases the proportion of members to be appointed on allotments committees as representing the interests of

occupiers of allotment gardens in the Borough or District. In future the number of such members must be as nearly as possible one-third of the total number of members of the committee and in no case less than two.

This section is to come into operation on 1st November, 1925, and Councils to which it applies should forthwith take the necessary steps to conform to its requirements.

Section 13 requires that certain particulars as to the purchase price or rent of land acquired for allotments and the amount of its assessment for rating purposes shall be recorded by the local authority, and included in the annual report required to be made under Section 59 of the Small Holdings and Allotments Act, 1908.

The Ministry has urged Councils of urban areas to do everything that lies in their power to extend the area used for allotments so far as may be necessary fully to meet the demand, and thereby to encourage and foster a movement which has a definite social and economic value, and of which the benefits are not confined to those who actually take part in the cultivation of allotments.

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NOTICES OF BOOKS.

Experimental and Research Station, Nursery and Market Garden Industries Development Soc., Ltd., Cheshunt: Tenth Annual Report, 1924.—This research station was started in 1914, so that the passing of the year 1924 marked the termination of the first decade of its existence, and it was decided quite wisely to include in the Annual Report a short note on the work that has been performed during the ten years:—" A Retrospect, 1915-1924," by the President, Mr. H. O. Larsen, and the Treasurer, Mr. C. H. Shoults. These two growers, together with the late Mr. W. B. Randall, have rendered most valuable service to the industry and to the nation in helping to establish the infant station in 1914 to carry on the Rothamsted soil sterilisation work; in supporting the experimental station through its early stage and in encouraging the workers to delve into the mysteries concerned with the manuring and pest treatment of glasshouse crops. Few growers of tomatoes could afford to use fresh soil every year, and pests accumulated rapidly in used soil with corresponding crop decreases, so that few can deny that the station has justified its existence even by the advice and help it was able to give to the growers on soil sterilisation alone. As Mr. Larsen and Mr. Shoults point out, however, the serious Tomato Moth pest was also studied and Dr. Lloyd, the entomologist, was able to devise effective control measures, which are now widely used in the industry. Dr. Lloyd also gave methods for controlling White Fly by cyanide fumigation. Dr. Bewley discovered the causes of damping off of tomato seedlings together with reliable methods for controlling it. He also showed that stripe disease of tomato could be combated with dressings of potash; and showed the importance of maintaining the temperature above 77° F. to ward off sleepy disease or *Verticillium* wilt. Mr. Speyer, Mr. Owen and others, have carried out special investigations of one trouble or another and have added valuable contributions

to the sound service which this station has given. One can readily appreciate with what pride and interest the President and Treasurer penned the retrospect of the excellent work with which they have been associated.

A large section of the Director's Report for 1924 is devoted to giving the results of the manurial trials, and in view of the immense amount of money spent on manures the subject is of moment. Poor soils yield perhaps no more than 10 tons of tomatoes to the acre, whilst the highly manured soils give as much as 60 tons. The ultimate object of these experiments, which have been conducted over a series of years, is to determine the correct proportion of phosphatic, nitrogenous and potassic fertilisers for a satisfactory tomato mixture. One has only to examine the numerous tables of the report to note the influence of these manures on the crop. Gradually increasing quantities of sulphate of ammonia brought higher yields—from 40 tons up to 48 tons, 51 tons and 53 tons per acre—whilst the proportion of blotchy fruits became less and less. Increasing quantities of potash gave correspondingly larger yields. Year by year the trials yield some new knowledge, and a detailed analysis of the table of crops is well worth while.

Mr. O. Owen and Mr. P. H. Williams give a further report of their test of the German contention that increased yields can be obtained by charging the atmosphere with supplies of carbon dioxide, and last year a German apparatus was used to produce the gas, but it failed to maintain a sufficient concentration of gas in the houses and the crops obtained were quite ordinary.

The fungus pests of glasshouse crops are many, and it will take many years to tabulate them, to carry out the investigation of the life histories, and to work out effective and yet practical measures of control. In this report, Mr. R. W. Butcher has given an account of his investigations concerning "A Bacterial Disease of the Roots of Runner Beans," "The Wilt Disease of Cyclamen," and "A Bacterial Rot of the Tomato Stem," whilst Dr. Bewley has added a further recommendation for the control of the Soft Rot of the Arum by steeping for one hour in a 2 per cent. solution of formaldehyde.

A study of the entomological report should be made by all growers troubled with red spider or woodlice, for the entomologist, Mr. E. R. Speyer, shows that both can be kept in check by certain methods. The treatments must be carried out with great precision, of which the various steps are set out in detail and all who read cannot fail to be convinced of the infinite pains taken to secure really reliable results.

Bone Products and Manures.—(Thomas Lambert. London: Scott, Greenwood & Son. 3rd edit., 284 pp., 53 illus. 10s. 6d. net.) This is a revised and partly re-written edition, with additions to render it more complete. The first part of the volume describes the methods of treating bones for the extraction of fat and gelatine, the manufacture of glue, distillation of bones, etc., with descriptions of the plant used.

In the second part follow chapters on manures produced from bone and other waste organic products such as hoofs and horns, soot, etc., guanos, mineral phosphates, and various other manures, including potash, lime, ammonia compounds and fertilisers manufactured from the nitrogen of the air. The manufacture of superphosphates is specially treated, and the final chapter deals with the methods of analysis of the raw and finished products as carried out in the laboratory of a bone works.

Fruit Growing Do's and Dont's.—(J. Turnbull. London: Methuen. Price 2s. 6d. net.) Failure in fruit production is stated to be due to some trifling obstacle which can be overcome by the exercise of sufficient care, and Mr. Turnbull in this book outlines the practices that should be adopted in the cultivation of the soil and in the treatment of the trees to produce the best results. The advice given is really sound and practical and brought right up to date, for the writer is evidently familiar with the results of modern research in fruit growing.

The don'ts are excellent. Here are a few:— Don't plant until drainage has adequately been provided for. Don't burn turf, but dig it in, as it is the best kind of manure for fruit trees. Don't plant diseased stock. Don't dig the roots off fruit trees if they are expected to produce fruit. Don't omit routine spraying as a preventive, nor any other spraying rendered necessary by circumstances.

The varieties of fruit selected are the most popular commercial kinds; and though they are the best to grow for sale, some of the trees are not always suitable for growing in the limited space of private gardens.

Of bush fruits, no mention is made of the best red currants, Laxton's Perfection, nor of the best gooseberry, Lancer—when only one sort is grown—which is probably due to the writer's more intimate touch with the commercial plantation than the private garden.

In the main the book is a good little production on fruit growing and should be welcomed by all growers.

Crop Production and Soil Management.—(Joseph F. Cox, B.S.A. London: Chapman & Hall, Price 13s. 6d. net.) This book contains a mass of information, based largely on American experience, for the use of students " whether they are enrolled in a vocational school or college or at work in a farming occupation." The information is presented in a somewhat didactic tabloid form, and perhaps leaves too little scope for the imagination of the reader. As a summary of farming experience and of science applied to agriculture it may be welcomed by many agriculturists who have neither the time nor the inclination to probe deeply into the reasons for things.

The Lorette System of Pruning.—(By Louis Lorette, translated by W. R. Dykes, M.A. London: Martin Hopkinson & Co., Ltd. Price 7s. 6d. net.) From the sixteenth century to the present day it has been realised that trees of apples and pears if left to grow naturally are apt to become unshapely and to fail in furnishing the earlier formed branches with fruiting spurs, and various systems of pruning have been devised by which man could tilt the activities of the trees in the direction of fruit spurring, but no system has been more ingenious than that put forward in the early years of this century by M. Louis Lorette, Professor of the School of Agriculture, Wagnonville, near Douai, France. The Lorette system, which is a complicated system of summer pruning, is somewhat difficult to understand from the French writing, but in this admirable English translation the various practices are made clear to all possessed of a measure of pomological knowledge. The numerous photographs and illustrations are not only helpful in making the meaning clear, but supply evidence of the abundant fruiting of trees pruned by M. Lorette. Pear trees predominate in the gardens at Wagnonville, but the author claims that the system gives equally satisfactory results with apples.

British Birds.—(Roland Green, F.Z.S. London: The Ruskin Studio, 1½d. each.) A series of pictorial postcards consisting of coloured representations of British wild birds. The present series of six shows the kingfisher, jay, bullfinch, great tit, goldfinch, and chaffinch. Schools, etc., will be supplied at special terms for quantities.

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Foot-and-Mouth Disease.—There was a further outbreak of disease in the Southampton district on the 17th August, but as the premises involved were in close proximity to the earlier outbreaks an extension of the area under restrictions was considered unnecessary.

All restrictions in connection with these outbreaks were removed as from 20th September. A new outbreak occurred on 25th September at High Wycombe, Bucks. The usual restrictions within a radius of 15 miles of the premises have been imposed.

* * * * * *

Agricultural Exhibition in Egypt.—The Egyptian Royal Society of Agriculture will hold the 12th Agricultural and Industrial Show at Cairo in February and March, 1926, under the patronage of His Majesty King Fouad. Besides classes in the agricultural section for the exhibition of agricultural products, livestock, poultry, fruit, etc., th' industrial section will include steam and internal combustion engines, agricultural machinery and implements, means of transport and buildings.

The object of the exhibition is the development of Egyptian agriculture and industry and the promotion of the use of agricultural machinery and accessories. Articles from abroad will therefore only be admitted which have a direct interest for agriculture. The Direction will welcome the co-operation of overseas manufacturers of machines, implements and other articles within the scope of the show, which are suitable for use in Egypt.

Requests for space should be addresssed to the Directeur de la Societe Royale d'Agriculture, B.P. No. 63, Caire, before the 15th October, 1925.

Fertiliser Regulations in France. - By a law of 19th March, 1925, the regulations controlling the trade in fertilisers in France have been made more stringent. The chief characteristics of the new law are:—

(1) The suppression of the sale of fertilisers under condition that the price is to be fixed according to the result of analysis.

(2) The tightening-up of the provisions of previous legislation requiring the seller of a fertiliser to furnish the buyer with all necessary information as to the nature and source of the fertiliser, the strength and origin of the fertilising elements which it contains, and their state of combination. The new law requires the seller to supply each buyer with a detailed invoice, even if the buyer does not ask for one. The seller must also attach to the wrappings a label bearing the required indication of the strength in fertilising elements, which must conform exactly to the composition of the product. This label may not bear any indications other than those prescribed by the legislation in force.—(*Board of Trade Journal, July, 1925.*)

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NOTES FOR THE MONTH.

Provision of Agricultural Advice.

The Ministry has recently been enabled to round off its scheme for the provision of technical advice in the principal branches of agriculture. Under this scheme advisory officers are appointed at Agricultural Colleges and the Agricultural Departments of Universities, each of which for this purpose serves a certain number of counties. The advisory centres are Armstrong College, Newcastle; the University of Manchester; the University of Leeds; the Midland Agricultural and Dairy College; Harper Adams Agricultural College; the University of Oxford; the University of Cambridge; Reading University College; Wye Agricultural College; the University of Bristol; the Seale-Hayne Agricultural College. In Wales there are Advisory Centres at the University Colleges at Bangor, Aberystwyth and Cardiff.

At each centre in England provision has now been made for advisers in agricultural chemistry, entomology, mycology and economics, and at the majority of centres provision is made for advice in dairy bacteriology. At one centre, namely Armstrong College, there is an adviser in veterinary science. In Wales there are at each of the three centres, advisers in entomology and mycology. There are advisory chemists at Aberystwyth and Bangor, advisers in veterinary science at Bangor and Cardiff, and an adviser in economics at Aberystwyth. Arrangements are, however, made by which the whole of the country is covered by these advisers.

The position of the advisory officers is sometimes misunderstood. With few exceptions, each County Council employs an Agricultural Organiser as well as a staff of agricultural experts. It is the duty of these officers to aid the farmer in any ordinary difficulty in which he may find himself in technical matters. The farmer's first recourse therefore should be to the county staff. There are, however, always a large number of questions demanding special study and special qualifications. It is when problems of this kind arise that the advisory officer should be

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called in. He is, in fact, very much of a research worker engaged in local problems of pressing importance in his own locality. The Agricultural Organiser will, in the ordinary course of things, consult the advisory officer where his assistance will be of value, and it is not, therefore, necessary for the farmer himself to approach the advisory officer.

The advisory officer does not, of course, sit down and wait for inquiries to come to him; he makes up his mind on the problems which demand investigation, and pursues one or more of them, and at the same time deals with such inquiries as fall within his province. Several of the advisory chemists, for example, are engaged on a soil survey of their areas. Others again may be specially interested in chemistry as applied to animal husbandry, and others in the application of chemistry to the control of plant diseases. The entomologists and mycologists act as intelligence officers of the Ministry in matters relating to plant diseases, and furnish monthly reports upon their areas, but they also undertake research into problems falling within their own field. The advisory economists are a comparatively new institution. One of their principal functions is to cost selected farms in their areas with a view to obtaining information on the economics of various forms of farm management; but their field of activities is wide. They are often called upon to advise on questions of farm accounts and farm book-keeping, and all problems of agricultural economics are of interest to them. The functions of the other advisory officers who have been mentioned are parallel. The veterinarians study and advise upon diseases which do not fall within ordinary veterinary practice. The dairy bacteriologists work upon the material provided by analyses of milk samples submitted to them in connection with clean milk competitions and otherwise.

The Ministry arranges that the advisory officers in each subject shall from time to time meet together to discuss matters of common interest. The advisers meet the members of the county staffs at provincial conferences and similar gatherings, as well as in the course of their daily work, and so are able to keep in touch with practical problems of agriculture; on the other hand, the advisers have opportunities for coming into contact with the research workers engaged at the agricultural research institutes. In this way a network of information and advice has been devised to cover the country, and there is practically no matter of difficulty in regard to which the farmer cannot get assistance. The Ministry itself provides a reservoir of information when the local sources are exhausted, and it deals in the course of the

year with many thousands of queries on an immense range of subjects.

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Agricultural Machinery Testing Scheme.

VERY shortly there will be available printed particulars regarding the Ministry's scheme for the testing of agricultural machinery. The object of the test is to furnish accurate information regarding the utility, efficiency, reliability and working costs of each machine or implement tested. Prospective purchasers will be able in this way to obtain reliable information as to the capacity of any machine which has been tested; but the machines will not officially be placed in any order of merit. Each machine or implement will be tested individually, and the certificate and report which will be issued will relate to that one machine or implement; but any machine or implement tested will be representative of those placed on the market. The certificate will state the bare facts of the test: the report may contain expressions of opinion with regard to the design and performance of the machine. In certain cases, as, for example, where a machine is in the experimental stage and not yet on the market, a confidential report may be furnished for the information of manufacturers. All the arrangements will be in the hands of a scientific committee.

Application for copies of the regulations and conditions should be made to the Ministry.

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Fish Meal.

COMPLAINTS have recently reached the Ministry that there has been an increase in the number of carcasses which, as pork or bacon, have had a fishy taint. A warning to pig-feeders is therefore timely. Users of fish meal should be careful to see (1) that any meal they may feed is of standard quality, and (2) that it is not fed to excess. The meal should be made from white fish only, and should not contain more than 5 per cent. of oil. If the meal is free from oil, so much the better, since many pork-breeders and bacon-curers object to the feeding of fish meal containing any oil whatsoever. Many buyers, indeed, refuse to purchase pigs known to have been fed with fish meal at all. Fish meal should never form more than one-tenth part in weight of the total ration. All rations of which it forms an ingredient should be carefully mixed, and self-fed pigs should not have access to fish meal unmixed. Meals bought ready compounded may contain some fish meal, and it is obvious that the user should know what a

compound meal contains before he determines how much fish meal to add. Unless a feeder is prepared to take scrupulous care, or to make sure that scrupulous care is taken, in the feeding of fish meal to pigs, he should never use it. Nothing is more foolish than to suppose that because a little fish meal may do good, a little more will do better.

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The Ely Beet Sugar Factory.

THE Ely Beet Sugar Factory, opened by the Minister of Agriculture on 15th October, is one of the six new factories promised in connection with the passing of the British (Sugar) Subsidy Act, 1925. In addition to the factories working last season—namely, Cantley (Norfolk) and Kelham and Colwick in Nottinghamshire—there will be ready for operation this manufacturing season :—

Ely (Cambridge),	Ipswich (Suffolk),
Spalding (Lincolnshire),	Bury St. Edmunds (Suffolk),
Kidderminster (Worcestershire),	Wissington (Norfolk),
	Greenock (Scotland).

Probably a further eight factories will be erected next year, which will call for a substantial extension of the present beet area of 55,000 acres. Whether these factories will, in 1926, secure sufficient beet to keep them in full employment depends entirely on the will of the farmer, who has an opportunity, during the higher rates of the subsidy, of gaining experience of this new crop with little risk. With the assistance of the Employment Exchanges and the National Farmers' Union Sugar Beet Committee, the labour problem should not prove a serious difficulty. As regards the price to the grower, an arrangement has been arrived at between the National Farmers' Union and the Factory Companies under which the grower shall receive not less than 54s. per net ton of beet delivered at the factory if he has contracted for the years 1926 and 1927. This minimum price also applies to this year's crop, except that in the case of new factories the minimum guaranteed price is 49s. for this year only.

The Ely Beet Sugar Factory is built on the banks of the River Ouse and covers an area of 66 acres. Four miles of sidings have been installed to deal with the beet traffic, and silos covering an area of 50,000 square feet have been constructed for the receipt of beets which come in by rail, road and water. The company has its own fleet of 50 barges, and promises to restore the use of some of the waterways with which the district abounds.

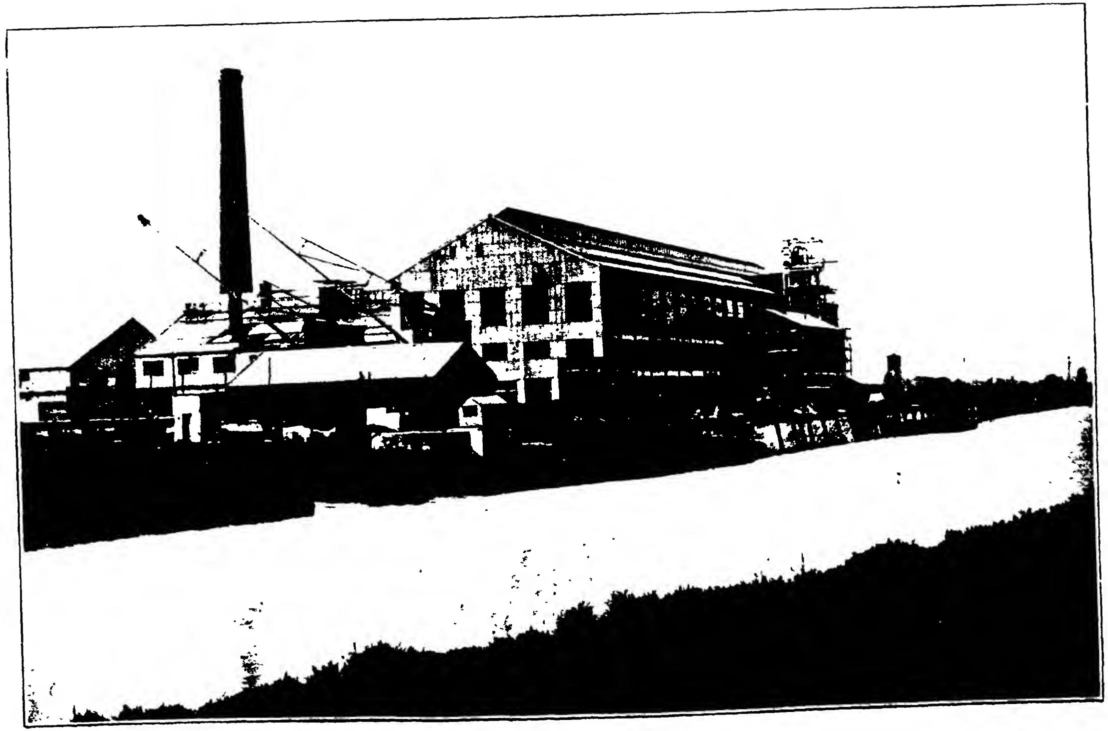

Fig. 1.—Ely Beet Sugar Factory.

The main building is 360 ft. long by 82 ft. wide and 52 ft. high. Behind it, but attached to it, are six separate buildings consisting of :—

The pulp-drying building	with	a	floor	area	of	9,500	sq.	ft.
The power house	,,	,,	,,	,,	,,	4,800	,,	,,
The lime building	,,	,,	,,	,,	,,	4,800	,,	,,
The boiler house	,,	,,	,,	,,	,,	16,000	,,	,,
The repair shop	,,	,,	,,	,,	,,	9,600	,,	,,
The sugar store	,,	,,	,,	,,	,,	16,000	,,	,,

The factory has a capacity of 1,200 tons of beet a day and can deal with 120,000 tons of beet during the manufacturing season. The output of sugar ready to be placed on the market when the full capacity of the factory is reached should not be less than 15,000 tons per annum. During the campaign now commencing 500 men will be employed in the factory.

The Minister, in formally declaring the factory open, stated that there were two particular reasons which in this case justified State action. Firstly, the experience of all countries had shown that for the establishment of the best sugar industry some measure of early assistance was necessary; secondly, there was the need of new crops and, it might be, new methods in British agriculture. In the Eastern Counties inquiries showed that beet was often the most profitable feature of the farm, and he did not think it was extravagant to hope that in a great many cases, on the lighter soils where corn growing might to-day be unprofitable, farmers would find a substitute in growing beet, and that on other soils beet growing, by its residual value, would enormously help and stimulate the production and cultivation of wheat. The Minister strongly urged the factories and the growers to regard the subsidy period as one, not of an existence made comfortable by the dole of State support, but of stern and unremitting preparation for the free competition which will follow.

Both factories and growers were essential to each other in the development of the new industry, but the growers were the lynch pin of the chariot.

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Mole Draining.

DURING the past autumn and winter, a number of County Councils made arrangements for demonstrations of methods of mole draining. These were highly successful, and have roused a great deal of interest among farmers and landowners, many of whom were not previously aware that mole ploughs had been devised which could be easily drawn by a good agricultural tractor. Again this season County Councils are holding demonstrations which are attracting large gatherings. It is understood, too, that the makers of tractor mole ploughs are selling a considerable number of implements. There is every indication, therefore, that the arrears in field drainage should be made good, and that, although in a very large number of cases where drainage is required the cost of tile-drains is prohibitive, farmers have an alternative method to hand which is at once cheap and effective. The process of mole-draining by direct haulage was recently described in this *Journal* (July, 1925, p. 303).

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Proposed Tour of British and Irish Farmers to South Africa.

IT will be remembered that during the past summer a party of South African farmers paid a visit to this country for the purpose of studying the conditions of British agriculture, and included in their survey many famous centres—farms, colleges, research stations, and the Royal Show at Chester. The South African National Union is now organising a return visit of British and Irish farmers to visit all the more important agricultural centres in South Africa, during which all types of farming practised will be seen. Some 5,000 miles will be covered in the 60 days' land journey, which will include a visit to the Victoria Falls and certain parts of Rhodesia. The tour is receiving recognition from the Union Government, and the National Farmers' Union is also co-operating in the project. The party will be restricted to 100 bona fide farmers, and a large number of applications and inquiries have already been received. The cost of the tour will be £165, which will include second class return passage from London to Cape Town, railway travelling in South Africa according to itinerary, and full board and lodging throughout the tour. Further particulars may be obtained from the South African National Union, 237-238, Moorgate Station Chambers, London, E.C.2.

SECTION 2 of the Allotments Act, 1925, authorises the Public Works Loan Commissioners, subject to such conditions and during such period as the Treasury may prescribe, and up to an aggregate amount approved by the Treasury, to lend money to approved Societies for the purpose of purchasing land to be used as allotments.

Allotments Act, 1925.

In accordance with the provisions of this section the Treasury have directed that the following conditions shall be observed by the Public Works Loan Commissioners in making advances under Section 2:—

(1) The period during which such advances shall be made shall not exceed five years from 7th August, 1925.

(2) The aggregate amount advanced shall not exceed £50,000.

(3) The Commissioners shall satisfy themselves that a society making application for a loan is an " approved society " within the meaning of the section.

(4) Before making any advance the Commissioners shall take such steps as they consider necessary or desirable, to satisfy themselves (i) as to the title to the lands in respect of which the loan is made, (ii) as to the title of the society to the other land or property (if any) to be mortgaged or charged under Sub-section (2) of the above-mentioned section; (iii) that the amount proposed to be advanced does not exceed two-thirds of the value of the land to be purchased as certified by the Valuation Office of the Inland Revenue; (iv) that an amount equal to one-third of the value of the land to be purchased has been provided from other sources in a manner approved by the Commissioners, and has been, or will be, expended in part payment of the purchase price of the land to be mortgaged.

(5) The mortgages in favour of the Commissioners shall contain such covenants as the Commissioners may be advised are necessary for the security of the loan.

(6) The rate of interest chargeable on advances made by the Commissioners shall be such as the Treasury may from time to time direct. On loans made after the date of this Minute until further notice the rate shall be 5 per cent. per annum.

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THE Departmental Committee on Rationing of Dairy Cows was set up by the Ministry to consider the various schemes of giving advice to farmers on the systematic rationing of dairy cows. The Committee's report has just been published by H.M. Stationery Office (price 6d., post free 7d.).

Rationing of Dairy Cows.

The systems of advice at present in operation throughout the country are analysed in Part I of the report, the Committee's main conclusion being that the general administration of a scheme of advice, uniform in its main principles, is both practicable and desirable.

The Standard Scheme, which is outlined in Part II, aims at regular and consistent dieting of cows with a view to maintaining them in good condition and encouraging them to yield the maximum commercial amount of milk. The main features of the scheme may be summarised as follows:—

(1) Utilisation of the existing milk-recording societies as extensively as possible.

(2) Application of standard values, assessed on a uniform basis, to the home-produced foods fed by the farmer.

(3) Adoption of agreed scientific standards of feeding for maintenance and production.

(4) Importance of personal touch between the adviser and the advised.

(5) Recording and summarising the results obtained over a definite winter period.

The Appendices to the report contain full information regarding the food requirements of the various types of cows, and data are given for calculating the cost and nutritive value of all common feeding stuffs, in order that rations may be compiled on a scientific basis and that they may be as cheap as possible, compatible with efficiency.

Systematic rationing is rapidly coming into favour amongst dairy farmers, and considerable savings in cost of milk production have already been effected by feeding cows on scientific lines. The Committee included members with intimate scientific knowledge of the food requirements of cows, and practical experience in the organisation and administration of schemes of advice to farmers, and its report is of importance to all dairy farmers who are anxious to obtain the maximum production of milk at a minimum cost, at the same time maintaining the health of their cows in full vigour.

Poultry Films.

A SPECIAL private view of some films descriptive of various aspects of modern British poultry culture was given, by courtesy of the British Instructional Films, Ltd., on 21st October. These films show the stages of commercial egg production from the hatching and rearing of the laying stock (hens and ducks) to the marketing of the eggs; the commercial production and marketing of table poultry (fowls, ducks and turkeys); and deal briefly with educational, experimental and research work in connection with the poultry industry. The films have been prepared by the British Instructional Films, Ltd., in collaboration with the Ministry, and at the private view referred to were seen by a large audience representing county authorities engaged in poultry educational work, agricultural colleges, the principal poultry societies, the poultry press and the Ministry. It is hoped that these films will be of considerable use for educational purposes when released. At the time of going to press it is not known when they will be available for purchase or hire, though it is understood that the films will be released at an early date. Inquiries as to rates for hiring or purchase should be addressed to British Instructional Films, Ltd., Regent Studio, Park Road, Surbiton, Surrey.

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Pig-Keeping.

THE Ministry has just published a new Miscellaneous Publication on "Pig-Keeping,"* which consists substantially of the articles contributed to Vol. XXX of this *Journal* by Mr. W. A. Stewart, M.A., B.Sc. (Agr.), Principal of the Northamptonshire Farm Institute, Moulton. These articles have been carefully revised, and supplemented by the addition of the Ministry's Leaflets on Pigsties and the Bacon Pig. The subjects discussed include such practical matters as the farmers' aim, scale of business, capital required, duties of the pigman, general management and the selection of suitable breeds. The principles of feeding are fully explained and typical rations are worked out for different classes of pigs, valuable advice being given on the feeding and management of breeding stock. The construction of pigsties is dealt with at some length, and plans of the various types of piggeries are given, including cottagers' piggeries in timber and in brick, the adaptation of a normal set of farm buildings, and the American "Hoghouse." The portable equipment for open-air pig-keeping is also fully described and illustrated, and the general methods of pig-keeping on those lines are noticed.

* Miscellaneous Publications, No. 48, obtainable from the Ministry, 10, Whitehall Place, London, S.W.1. Price 1s. net (post free).

Coloured Wall Diagrams of Plant Pests and Diseases.

THE September (1925) issue of this *Journal* contained a reduced monotone reproduction of the first of a series of coloured wall diagrams illustrating pests and diseases which attack agricultural and horticultural crops. In this issue is included a similar reproduction of the second of the series having Winter Moths as its subject. Four of these wall diagrams have now been produced by the Ministry, the other three illustrating (1) the Apple Blossom Weevil, (3) Apple and Pear Scab, and (4) Silver Leaf. Measuring 30 in. by 20 in., technically correct and finely printed by the four-colour process, these diagrams should prove highly valuable to agricultural, horticultural and allotment societies; to local education authorities for use in rural schools; to museums, colleges and public schools; to farmers and fruit growers; and to private individuals. The price of each diagram, unmounted, is 3s., or mounted and on rollers 5s. (post free). With each diagram a descriptive leaflet is issued free.

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Agricultural Atlas of England and Wales.*

STATISTICS of the acreage of crops and numbers of live stock on farms in England and Wales have been collected by the Ministry for many years, but in the form in which they are generally available, only the statistics in each county can be obtained. It is known, however, that systems of cropping and the distribution of live stock vary considerably within counties, and that the county data do not localise farming practice. With a view to indicating as far as possible on a small scale, these local differences, together with some of their causes, an extremely interesting and novel Agricultural Atlas of England and Wales has been prepared by the Institute of Agricultural Economics at Oxford. The atlas consists of a series of maps, showing by means of uniform dots, the distribution of the various crops, live stock, etc., in England and Wales in the year 1918. The value of the dot is shown for each map, and from the text accompanying them the acreage of crops or number of live stock can be ascertained.

The causes of difference in the distribution within each county or over the county may be geological, climatic or economic in character. A geological map is therefore included, though the soil of the surface varies much more than the map indicates,

*Obtainable from the Ordnance Survey Dept., Southampton. or the Ministry of Agriculture, 10, Whitehall Place, London, S.W.1, price 10s.

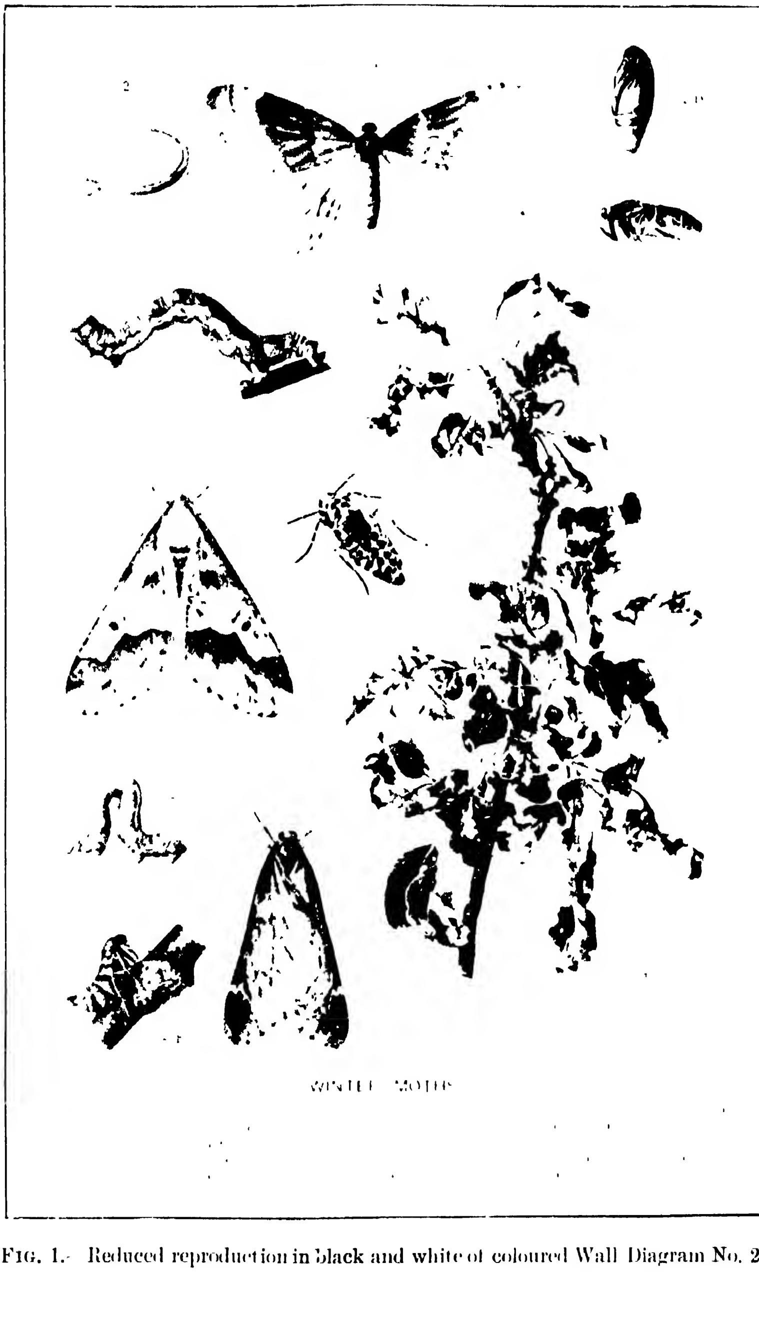

FIG. 1.- Reduced reproduction in black and white of coloured Wall Diagram No. 2.

because of the soil drifts. Climatic conditions are jointly indicated by relief and rainfall maps, though the small scale on which they are produced does not admit of complete localisation of all variations. No attempt has been made to provide a chart of economic conditions, but the map showing the situation of market towns indicates in some measure the localities in which the chief part of the urban population is to be found.

An atlas of this kind should serve many purposes. It will help the investigator desirous of examining some particular branch of the agricultural industry by enabling him to locate at a glance the farming practice or food product with which he is concerned. But it should do more than this; very little information has been available hitherto on the correlation of surface geology, of rainfall, of altitude or of economic factors with various forms of agricultural practice met with in England and Wales, and the series of maps now published should do much to facilitate research work in these directions. Further, the atlas should prove useful for educational purposes.

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The Improvement of Grassland.

THE two most striking facts about English grasslands are their extent and their poor condition. There are in England and Wales some 22½ million acres of grassland, including rough grazings, the return from which in many cases could easily be doubled and in some cases even trebled and quadrupled without much trouble or expense. The question of grassland improvement has formed the subject of very numerous experiments in the past twenty years—notably by Professors Somerville, Gilchrist and Stapledon—and there is available a large store of knowledge of the measures most suitable for the different kinds of grassland. In 1920 a review of all the experimental work was made by the Ministry of Agriculture, the leading authorities on the subject being consulted, and the information so gained was put into a form suitable for the practical farmer and issued as a pamphlet entitled "The Improvement of Grassland." This pamphlet met with a ready sale and a reprint soon proved necessary.

In the same year, on representations being made by the Ministry, local agricultural education authorities readily admitted the importance of the subject, and for the most part agreed to carry out demonstrations of approved methods of improvement at numbers of centres in their various areas; altogether some 700 such demonstrations have been or are being

carried out. These demonstrations are furnishing a large amount of valuable information; in addition experimental work has continued since 1920 at Cockle Park, at Rothamsted, at Aberystwyth, and, largely under the ægis of the Agricultural Education Association, at various county centres. The further knowledge thus gained rendered necessary a complete revision of the Ministry's pamphlet; this task was entrusted to Dr. J. A. Hanley, the chief advisory officer in agriculture at Bristol University, whose services have been freely placed by the University at the Ministry's disposal in connection with grassland work. The resulting volume which has just been issued, "The Improvement of Grassland" (Ministry of Agriculture, Miscellaneous Publications, No. 24, price 8d.), should be helpful to all farmers, in particular to those whose grassland is not of the highest quality.

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Wart Disease of Potatoes.

FARMERS who grow for seed potatoes of varieties which are immune from Wart Disease were recently informed by the Ministry that it was too late in the season for the Ministry to arrange inspections of their crops for issue of certificates vouching for the purity of the variety. The applications received this season were nearly three times as numerous as in 1924, *i.e.*, 664 applications for the inspection of 3,639 acres, as against 237 applications for 1,600 acres. More than 3,200 acres had already been examined, and it was hoped that the remainder would be dealt with before the haulms of the crop had died off.

Farmers can, however, still obtain "Clean Land" certificates under the Wart Disease Order, so that they can quote the number of the certificate in any sale of seed which they may make, as required by the Order. So far, this season, 1,393 "Clean Land" certificates have been issued in respect of 23,364 acres, as against 976 certificates in respect of 23,994 acres at the corresponding date last year. Those who have not yet obtained certificates should apply at once, in case inspection (which must be done when the crop is being lifted) is necessary.

In regard to the general position of Wart Disease, it is satisfactory to record that outside the main Infected Areas only 24 new cases of disease have been confirmed this season, of which only 3 were in parishes not already known to be infected. With one exception they were all in small gardens or allotments. By the same date in 1924, 82 fresh cases had been found, involving 8 new parishes.

Enforcement of Minimum Rates of Wages.

Although the majority of farmers appear to be observing their obligations under the Agricultural Wages (Regulation) Act to pay wages at not less than the minimum rates fixed by the Agricultural Wages Committees, a certain number of exceptions have been discovered as the result of investigations by the Inspectors appointed for the purpose. A number of cases have been settled by the payment of arrears of wages, but in certain instances the Ministry has felt bound to take a more serious view and has instituted legal proceedings against the employers concerned. In the case of all the 18 employers against whom proceedings have so far been instituted, the Bench has found that an offence has been committed. The total fines imposed amount to over £50, costs to £33, and arrears of wages ordered to be paid to £116. In a case heard at Rotherham, in addition to fining the defendant £10 and ordering the payment of costs and arrears of wages, the Bench intimated that, in the event of another such offence being proved before it, the maximum penalty of £20 would be inflicted.

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Export of Horses to the Continent.

The Report* of the Committee, appointed by the Minister of Agriculture and Fisheries in March last, to inquire into the conditions of the export trade in horses from this country to the continent has now been published.

In the course of their inquiry the Committee received evidence from the majority of the societies interested in the prevention of cruelty to animals; from many of the horse breeding societies; from representatives of the shipping interests concerned, as well as from officials of the Ministry and dealers in horses intended for export to the continent.

Members of the Committee have visited the ports in this country from which horses are shipped; they have travelled with the horses to the continental ports, and have also visited the abattoirs on the continent to which British horses are taken.

In view of the widespread interest which has been manifest in the traffic, a verbatim Report of the evidence is being published, including the full regulations of the Ministry governing the traffic as well as statistical tables giving particulars, not only of the trade in live horses, but also of the trade in horse carcasses to the continent which has grown considerably during the last four years.

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* Cmd. 2495, obtainable from H.M. Stationery Office, or through any bookseller, price 1s. Minutes of Evidence, separately, price 30s.

THE CONTROL OF LIVER FLUKE IN SHEEP.

C. L. WALTON, Ph.D., M.Sc., and W. NORMAN JONES, B.Sc.,
Department of Agriculture, University College of North Wales, Bangor.

History of Experiments in North Wales to 1925.—In 1920-21, North Wales suffered from a severe epidemic of Liver Rot, during the progress of which the senior writer commenced duties as Adviser in Agricultural Zoology. *Limnæa truncatula*, the recognised host snail, was found to be present in the affected districts in enormous numbers, and means were considered for its control. Among other things copper sulphate, which had been found effective for the destruction of snails by workers in the U.S.A., was tried at the suggestion of Captain Daubney, then a member of the laboratory staff of the Ministry of Agriculture. Experience in Mid-Wales had led to the opinion that lime and salt, previously advocated as useful for this purpose, were of doubtful value. Field experiments carried out in June, and again in October and November, 1921, in various centres in North Wales indicated that 1 per cent. solutions of copper sulphate were effective, and that a dust of one part copper sulphate and two parts of powdered kaolin (china clay) was also successful (1), (2), and (3). The Ministry advocated the use of copper sulphate in Leaflet 89, re-written in August, 1921. The summer of 1921 was exceptionally hot and dry, and effected so complete a natural control of the snails that it became very difficult to obtain places for further experimentation. Subsequently, the summer of 1922 was unusually wet and sunless, and this resulted in an increase of snails, and during the winter 1922-23 a few minor complaints were again received from some of the wettest farms. Experiments conducted in Anglesey during December, 1922, and March, 1923, in order to test sulphate of ammonia against sulphate of copper under field conditions (5) resulted in the failure of sulphate of ammonia and a further marked success of copper sulphate.

Wet, dull weather prevailed throughout 1923 and 1924, resulting in a great increase and spread of all species of Limnæa, and a recurrence of Liver Rot in epidemic form in many places. The Advisory Leaflet (3) was re-written and revised, giving further details, but during the winter of 1924-25

(1), (2), etc., see references on p. 693.

it became evident that the methods could be further simplified, cheapened, and extended, and to this end numerous field experiments were carried out. These are now described, together with other details that have accumulated during practice.

It may be noted here that observations by Dr. Monica Taylor (6) and one of the writers (7) have indicated that *L. peregra* may also act as a host for *Distomum hepaticum*, the Liver Fluke. Three species of Limnæa are common in North Wales: *L. truncatula*, the most abundant, widespread and dangerous; *L. peregra*, a larger form, which is seldom found apart from soft mud in ditches, etc.; and *L. palustris*, a much more local species, not so far implicated as a host for the Fluke.

Field Experiments in 1925.—In all the field trials, plots were selected as far as possible to illustrate all types of land, and *L. truncatula* was abundant on all. The most heavily infested plots were measured out, demarcated by means of numbered pegs, and made as equal as circumstances allowed. Series were treated as simultaneously as possible, and the subsequent collection of snails also. All snails were then removed direct to the laboratory and placed under water in dishes for 24 hours, after which a first count was made. One or two further check counts were subsequently made in all cases. In many instances collection after treatment is by no means easy, especially if the results have been successful. Dead snails sink rapidly in soft mud; heavy rain may raise the water level and cause muddiness, and long grass and herbage obscures small dead snails, especially when these are situated in cracks, crevices and holes. Such difficulties have several times resulted in disappointing counts and subsequent repetition of experiments.

Spraying was done by means of a Holder-Harridan Automatic Knapsack (except Plots 15 and 16, which were treated by means of a syringe). In dusting a small hand bellows was used. Proportions indicated in the following field experiments are by weight.

SERIES A.—**Hendre Boeth, Llangoed, Anglesey, 29th-31st April, 1925. Weather fine and bright; showers soon after treatment, otherwise fine.**

***Plot* 1.—Area: 25 sq. yd. grass land. Ground dry and snails on surface, which was fairly smooth, and herbage short.**
Application: Spray, alum 10 per cent.
Result: 104 *L. truncatula* collected; 1 dead, rest alive.

Plot 2.—Area: Contiguous to 1, and land similar.
Application: Spray, alum 5 per cent.
Result: 138 *L. truncatula* collected, all alive.

Plot 3.—Area: As in 1 and 2. Land similar.
Application: Spray, alum $2\frac{1}{2}$ per cent.
Result: 100 snails collected, all alive.

Plot 4.—Area: 25 sq. yd. Land similar to 1, 2, and 3.
Application: Plot untreated.
Result: 116 snails recovered, all alive.

Plot 5.—Area: 22 sq. yd. Ditch, drying, but mud soft and wet, and with shallow holes full of water here and there.
Application: Dust, copper sulphate 1 part; kaolin (china clay) 2 parts.
Result: 114 snails collected, all dead.

Plot 6.—Area: 44 sq. yd. Same ditch (22 sq. yd. on either side of Plot 5).
Application: Plot untreated.
Result: 115 snails collected; 12 dead, 103 alive.*

Plot 7.—Area: 25 sq. yd. Soft damp mud, part of a drying pool in a grass field. Grass tufts here and there. Many snails in hollows.
Application: Spray, copper sulphate 1 per cent.
Result: 131 snails collected, all dead.

Plot 8.—Area: 25 sq. yd. Adjoining and similar to 7.
Application: Spray, copper sulphate 2 per cent.
Result: 182 snails collected, all dead.

Plot 9.—Area: 25 sq. yd. Adjoining and similar to 8.
Application: Plot untreated.
Result: 60 snails collected; 2 dead, 58 alive.

Plot 10.—Area: 25 sq. yd. Shallow grassy ditch, partly dried out, partly shallow water.
Application: Broadcast, copper sulphate 1 part; coarse sand, 2 parts.
Result: 52 snails collected, all dead.

Plot 11.—Area: 25 sq. yd. Damp grass land; vegetation short.
Application: Plot untreated.
Result: 82 snails collected; 5 dead, 77 alive.

SERIES B.—Bryn Gôf, Llanfair P.G., Anglesey. April 29th-May 1st. Weather fine at application, followed by rain.

Plot 12.—Area: 72 sq. yd. Wet pasture land with coarse grass and rushes.
Application: Broadcast, copper sulphate, 1 part; sand, 2 parts.
Result: 17 snails collected; 15 dead, 2 alive.

Plot 13.—Area: 72 sq. yd. Plot adjoining 12 and land similar.
Application: Broadcast, copper sulphate only (2 lb. 6 oz. used).
Result: 16 snails collected; 14 dead, 2 alive.

Plot 14.—Area: 72 sq. yd. Adjoining 12 and 13 and land similar.
Application: Plot untreated.
Result: 55 snails collected; 4 dead, 51 alive.

* The dead snails in this (and other) control plots represent natural death rates—in this instance due to the drying out of a few patches of mud.

SERIES C.—Tre Wyn, Llanerchymedd, Anglesey. May 7th-9th, 1925. All plots at this centre were on the same field, a six-year ley (pasture) on heavy soil, waterlogged in parts. Vegetation short from recent grazing. Land damp when treated and heavy showers followed immediately. Further heavy rain prior to and during collection. A strong wind was adverse to dusting. At collection, land sodden and water in pools turbid, whilst observation was rendered more difficult by large numbers of dead earth-worms which blocked the hollows in which most of the snails were found. This result was unusual, and probably due to the heavy rainfall. Dead worms are frequently present in small numbers, but not in any way comparable to this experience.

Plot 15.—Area: 44 sq. yd.
Application: Spray, copper sulphate ½ per cent.
Result: 27 snails collected; 25 dead, 2 moribund (died soon after).

Plot 16.—Area: 22 sq. yd.
Application: Plot untreated.
Result: 31 snails collected, all alive.

Plot 17.—Area: 66 sq. yd.
Application: Dust, copper sulphate 1 part; kaolin, 4 parts.
Result: 30 snails collected; 27 dead, 3 alive.

Plot 18.—Area: 22 sq. yd.
Application: Broadcast, salt at 10 cwt. per acre.
Result: 15 snails collected; 7 dead, 8 alive.

Plot 19.—Area: 22 sq. yd.
Application: Broadcast, copper sulphate only (8 oz. used).
Result: 40 snails collected; all dead.

Plot 20.—Area: 22 sq. yd.
Application: Broadcast, copper sulphate, 1 part; sand, 3 parts.
Result: 8 snails collected, all dead.

Plot 21.—Area: 22 sq. yd.
Application: Broadcast, copper sulphate, 1 part; sand, 2 parts.
Result: 32 snails collected, all dead.

Plot 22.—Area: 22 sq. yd.
Application: Plot untreated.
Result: 30 snails, all living.

SERIES D.—Bryn-Gwyn Hall, Llanfair P.G., Anglesey. May 21st-23rd, 1925. Rich, wet meadow land, with strong growth of grass, 4-8 in. high. Experiment put down in dry weather. A sharp shower fell three hours prior to snail collection. Dusts were not fully washed down from the long grasses. Hollows beneath vegetation full of water.

Plot 23.—Area: 22 sq. yd.
Application: Dust, copper sulphate, 1 part; kaolin, 4 parts.
Result: 20 snails collected, all dead.

Plot 24.—Area: 22 sq. yd.
Application: Duplicate of 23.
Result: 23 snails collected, all dead.

Plot 25.—Area: 22 sq. yd.
Application: Broadcast, sulphate of iron at 10 cwt. per acre.
Result: 17 snails collected; 4 dead, 13 alive.*

Plot 26. Area: 22 sq. yd.
Application: Broadcast, copper sulphate, 1 part; sand, 4 parts.
Plot 27. Area and application: Duplicate of 26.
Result: 71 snails collected, all dead. Plots combined during collection.

Plot 28.—Area: 22 sq. yd.
Application: Plot untreated.
Result: 37 snails collected; 8 dead, 29 alive.

Plot 29.—Area: 54 sq. yd.
Application: Spray, copper sulphate ½ per cent.
Result: 80 snails collected, all dead.

Plot 30.—Area: 22 sq. yd. Wet mud on margin of stream.
Application: Sulphate of ammonia (dry neutral) at 5 cwt. per acre.
Result: 64 snails collected, all dead.

SERIES E.—Plas Llanfaglan, near Carnarvon. May 29th to June 4th, 1925. Rather rough, level, waterlogged grass land, much "poached" by cattle, and with strong coarse vegetation. In every way difficult to treat and examine. Experiments put down in very strong wind after heavy rain, and land partially flooded. Collection had to be delayed to allow surface water to subside.

Plot 31.—Area: 110 sq. yd.
Application: Broadcast, copper sulphate, 1 part; sand, 8 parts.
Result: 40 snails collected, all dead.

Plot 32.—Area: 110 sq. yd.
Application: Broadcast, copper sulphate, 1 part; sand, 4 parts.
Result: 48 snails collected, all dead.

Plot 33.—Area: 110 sq. yds.
Application: Broadcast, duplicate of 32.
Result: 64 snails collected, all dead.

Plot 34.—Area: 44 sq. yd.
Application: Broadcast, copper sulphate, 1 part; sand, 8 parts.
Result: 58 snails collected, all dead.

Plot 35.—Area: 22 sq. yd.
Application: Dust, chloride of lime.
Result: 57 snails collected; 32 dead, 25 alive.†

Plot 36.—Area: 44 sq. yd.
Application: Plot untreated.
Result: 21 snails collected; 5 dead, 16 alive.

* The living snails were kept under observation in the laboratory, and after a further 24 hours, several others died. Eventually only one remained alive.

† The living continued under observation, and ultimately 7 remained alive.

Conclusions.—From the foregoing it will be seen that copper sulphate proved successful when (1) sprayed, (2) dusted, (3) broadcast.

1. *Spray.*—Solutions of 2, 1 and $\frac{1}{2}$ per cent. were all equally effective under varied field conditions. The method is especially suitable for damp land. Where the land is waterlogged, or there is much standing-water present, there is a possibility of a $\frac{1}{2}$ per cent. solution becoming too dilute to be effective (although such a case has not yet been experienced), and it would, under such conditions, probably be advisable to use 1 per cent., or even, in extreme cases, 2 per cent. solutions, as a precaution. On the other hand, snails may remain alive on land that has become partially dried and it is then essential that the surface shall be thoroughly wetted. The amount of fluid required to do this will obviously vary with conditions. On plot 29, where the land was damp below heavy herbage, the amount used works out at 137 gallons per acre, with shorter herbage less would be needed, and on damp mud still less.

A difficulty arises in the use of this method in some country districts owing to the absence of large spraying outfits and further, that the majority of labourers are quite unused to even knapsack machines. An advantage of sprays is rapid toxic action, whilst risk to stock is slight. Alum sprays were not satisfactory.

2. *Dust.*—Copper sulphate, one part by weight, kaolin (china clay), four parts by weight, has proved successful. Kaolin is used as a "carrier," and also marks out the area treated. Flour can be used as a substitute, but is much more expensive. The method is excellent for small areas, narrow ditches, margins of ponds, and so forth, and is easy to mix and apply, but requires suitable dusting or dry spraying apparatus which is generally unknown on farms and more usually employed by gardeners, and fruit and market growers. Dusts are particularly useful where clean water is difficult of access. The toxic action is generally slower, depending to a considerable extent on rain (especially if there is much vegetation) and stock should be excluded from treated areas until sufficient rain has fallen to wash the grass clean. Plot 23 works out at 27½ lb. copper sulphate and 110 lb. kaolin, roughly 1¼ cwt. per acre.

3. *Broadcast.*—One part copper sulphate to four, and one to eight of fine, dry sand (Plots 31, 32, 33 and 34 in particular), proved suitable for treating large areas of swampy land, etc.,

which are often too soft for spray or dusting machines to be used. Perfectly simple to mix, and applicable by any labourer. The distribution must be as even as possible, and the sand quite dry. No modern manure drill was available for use in these experiments, and the older types tend to distribute the dressing in rows. This method also depends on moisture for quick action, and is best employed on wet land, or before rain. The remarks regarding stock apply as in the case of dusting. Plots 31 and 34 work out at 27½ lb. copper sulphate and 220 lb. sand, roughly, 2¼ cwt. per acre, and plot 32 at 27½ lb. copper sulphate and 110 lb. sand, or 137½ lb. per acre. Several plots treated by farmers with dry copper sulphate alone were examined, and found successful. A small quantity of kaolin mixed with the sand would be useful to outline treated areas. Sulphate of iron and salt were not satisfactory, bearing out previous trials. Sulphate of ammonia succeeded, but at prohibitive cost. Previous experiments using up to 2.6 cwt. per acre failed (5).

Costs.—Copper sulphate of 98-99 per cent. purity can usually be purchased retail at about 4d. or 4½d. per lb. Wholesale prices at present vary from 3d. to 4½d. per lb. according to the bulk ordered, the latter for 100 lb. bags carriage paid (taken from a quotation of a well-known firm).

Spraying with ½ per cent. solutions of copper sulphate (as in Plot 29) would cost (without labour) approximately 7s. 6d. per acre.

In dusting (as in Plot 28) the cost per acre would be nearly 10s. for copper sulphate, and about 2s. 3d. to 2s. 6d. for china clay (at ¼d. to ½d. per lb.). The additional cost of labour in each case will depend very largely on the time taken to apply, which again is governed by the size of the machine employed and the type of land treated.

Broadcasting (as judged by Plots 31, 32 and 34) will cost about 10s. per acre for copper sulphate, plus labour and cost of sand. The latter is usually readily obtainable, and application rapid and relatively cheap.

Summary.—1. A series of 36 field plots were laid down in April, May and June, 1925, further to test copper sulphate and several other substances applied as field dressings to control *L. truncatula*.

2. Copper sulphate continued to give good results, and was successful as a spray, as a dust, and broadcast, mixed with sand.

3. Sprays of ½ per cent. strength were successful, but under certain circumstances stronger solutions are suggested.

A dust of one part copper sulphate and four parts kaolin (china clay) proved efficient.

Broadcast mixtures of one part copper sulphate and four parts sand (and one in eight also) were found effective, easy of application and relatively reasonable in cost.

Sincere thanks are due to the occupiers of the land on which experiments were carried out, for much assistance in every way.

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CLEAN MILK PRODUCTION AND DISTRIBUTION.

S. STRATTON.

(Mr. S. Stratton is a small holder under the Surrey County Council, and in 1924 won the 1st prize in the County Clean Milk Competition. The following article gives an account of his own impressions, estimates and practices.)

To the ordinary farmer the subject of clean milk production is inevitably linked up with the question of the relative return on his investment of capital and effort. He cannot be expected to assume the rôle of public benefactor for the sake of the national health; or to take steps to improve the quality of his present product without some guarantee that he will not be a loser financially by so doing.

The Need and Demand for Clean Milk.—If in the present circumstances, necessitating no additional equipment, a man can readily sell all the milk he produces, and if, moreover, he sees little probablity of the wholesale buyer bearing any part of the extra cost of producing a cleaner article, then it is unlikely that there will be any marked improvement in the cleanliness of the milk delivered to the public.

It is not easy to determine whether cleaner milk is really in demand by the public, whose ignorance about milk and indifference to considerations other than the time it will keep in usable condition and the amount of cream it contains, are made evident by the ready sale which sterilised, pasteurised and condensed milks enjoy.

Clean fresh milk is stated by competent authorities to be one of the essential foods for young children. Yet, instead of insisting that milk should be clean enough for children to consume in a fresh, uncooked condition, housewives are content to " scald " all milk before using it, assuming that " stunned " or dead germs are less harmful than active or living ones. But cooking destroys some vitamins as well as germs, and scalded or heated milk lacks the pleasant, sweet flavour that is such a commendable quality in the clean, raw article; and anyone who is content to go on buying or using other than clean, fresh milk is delaying the day for national improvement in this respect.

Grade A milk costs more to produce than does ordinary milk, but not so much more as to make the price prohibitive. The development of its use is hindered, however, by the fact that many purchasers take no interest; and as long as the more

cheaply produced article finds a ready sale it will always be forthcoming.

Pre-supposing a real demand on the part of the retail buyer for the cleanest milk that can be produced at the ruling price, the main point is to ensure that clean milk production is profitable; and the purpose of these notes is to show that milk of Grade A standard can be produced at a cost that is not prohibitive either to the farmer, retailer or consumer.

How Grade A Milk may be Produced.—The writer cannot lay claim to a life-long experience of milk production, his knowledge of the subject having been gained by practical experience, and from sources of instruction and information provided by County Agricultural Committees chiefly during the last six years. He can, however, claim to be a producer of clean milk from the business man's point of view; having commenced to sell milk from his own cows about eighteen months ago with a daily sale of three quarts, and now selling the produce of fourteen cows.

Necessary Equipment.—An opportunity was provided by the first Surrey County Clean Milk Competition held in 1924 to discover whether with the extra equipment necessary, one could expect to produce clean milk. The extra equipment consisted of:—

(*a*) A "Grada" milk filter	£3	0	0
(*b*) Two Davies milking pails	2	0	0
(*c*) Milking overalls and caps	2	0	0
(*d*) Steriliser	1	10	0

The above are found to be absolutely essential. A few words as to the steriliser. Not wishing to purchase an expensive article, a steriliser was improvised from an existing copper; a large wooden lid with holes bored therein, rested on the copper, and above this was an inverted galvanised iron bin moved up and down with a pulley and rope. This equipment is sufficient to sterilise all ordinary dairy utensils, and was most satisfactory. A Barford and Perkins steriliser has now been installed for greater convenience.

Clean Work.—In the actual washing of utensils the order of procedure is as follows: they are first washed with cold water; then with hot water using "Sterolene"; then rinsed in cold water; and finally sterilised. When the old steriliser was used, as it was throughout the clean milk competitions of 1924 and 1925, the buckets, milk cooler, and filter had to be removed from it to make room for bottles, stools, etc., the buckets only

being placed upside down on a rack and the rest of the utensils put into a closed cupboard until required. With the new steriliser all utensils can be left in the steam chamber and there dried automatically; the steriliser is opened momentarily to let out the steam and then closed. With this method no tendency to rust has been noticed.

Weekly limewashing and monthly scraping of the cowsheds and cooling room are a necessity. Such work is not a luxury—a limewasher works very quickly and is an effective germ killer.

The Buildings.—The buildings are of the ordinary kind adapted for cowsheds, with steel yokes and standings, concrete floors, and open channel drainage. The shed in use at first had no lighting or ventilation; a glass louvre light 5 ft. by 3½ ft. placed in the south end wall, and two windows 3 ft. by 2 ft. facing west and east in the roof remedied these defects. The size of the cowshed with 14 standings is 45 ft. long by 15 ft. wide.

The milk cooling, bottling and sterilising plant is at the moment all in one room, 15 ft. by 12 ft. in area; this arrangement, though satisfactory, is not desirable and an existing shed is now being adapted to give two separate rooms for these purposes. The sterilising room will be 12 ft. square, and the cooling and bottling rooms 12 ft. by 15 ft.

An ordinary 15-in. cooler is here employed for cooling, water being used from a 1,000-gallon rain water tank in a covered yard. The temperature of the milk in this case was reduced to 52° F. in winter and 56° F. in summer, which appeared satisfactory as no complaints were received about the keeping qualities of the milk. In the new cooling room there is a 200-gallon tank into which water is pumped immediately before cooling from a 100-ft. well. With this it is now possible to obtain a summer milk temperature of 52° F.

Another drawback common to many farms is that the manure yard is adjacent to the milk cooling room, and the fact that the milk has to be carried through a chaff-cutting room which separates the cowsheds from the dairy presents a further difficulty. It is obvious, therefore, that such equipment and buildings are not those belonging to a rich farmer with "money to burn," as is frequently suggested by possible entrants for county clean milk competitions. In spite of these generally recognised drawbacks the writer has been able to send in samples of milk for analysis in the 1924 and 1925 competitions,

all of which would be classified as Certified Milk having regard to bacterial count and absence of coliform organisms.

Cleanliness.—There are, however, certain rules of procedure in the cowsheds which overshadow in importance most questions of buildings and equipment, apart from the fact that in all work it must be recognised that any handling of milk tends to increase its germ content.

Cows must be groomed daily; udders clipped and tails shortened when required and washed frequently. Before milking, the flanks and udders should be freely washed with plenty of water with one cloth and dried with another; this latter is an important detail. These cloths must be thoroughly washed and sterilised every day. Opinions appear to differ as to the effect of continued washing on the health of the udder. In my small herd since this treatment the cows have been free from udder trouble, and provided that the udders are well dried and that the water used is not too cold, there seems to be little fear of ill effects, but rather the contrary.

Litter should be absent from the cow standings while milking is in progress: where this is impossible it should be thrown forward clear of the milker. Mangers must be free from foods, especially hay and straw or those, such as turnips or silage, that may convey taints to the milk. The floor of the cowshed must be washed at least once a day, and it is a further advantage to have some disinfectant in the water. Cowmen must wear overalls and renew caps twice a week, and their hands must be kept scrupulously clean. This latter point is of primary importance; a clean towel daily and proper hand-washing accommodation are therefore required. If the milker's hands are not perfectly clean all other efforts to produce a clean sample are hindered. The fore-milk must be discarded. Milk is drawn into dome pails and carried immediately into the cooling room, not being allowed to stand about in the cowshed.

Cost and Distribution.—The allowance usually made of an extra cost of 1d. per gallon on an average output of 36 gallons a day (see table below) covers all charges for extra labour: a larger output would decrease this allowance. Unlimited capital and resources, with no necessity to makes the business pay, are not the prime factors in clean milk production. The writer commenced producing clean milk with the object of making more money than was being obtained by selling the milk in bulk. It was realised that it was impossible to compete with existing milk retailers when working on their lines, and it was

resolved to test the idea that a ready sale is always found for a better article at the same price. The results have justified expectations, and anyone who is prepared to bear the extra cost will no doubt have the same experience.

"Clean Milk: Bottled at the Farm" is the slogan. Any milk producer can enter for his County's Clean Milk Competition. The entrance fee will be his only expenditure in order to discover whether he can produce the commodity continuously. The grooming and extra attention to the cows must improve their health: clean, business-like, regular methods of procedure will be good for the morale and interest of the cowmen employed: surely the type of employé to whom improved and modern methods do not appeal is unsatisfactory in every way. Obviously it is not possible for every milk producer to become his own retailer: distance from a town, existing population, means of transport and like considerations make this impossible. On the other hand, if everyone for whom it is a practical proposition were to do so, on lines similar to those the writer has worked out for himself, the problem of clean milk production and delivery should be well on the road to solution.

For distributing the bottled milk, 2 Dunelt sidecar-van combinations specially designed for the purpose are used. The vans carry up to 20 gallons of bottled milk in wire crates with ease and reliability: the cost of running is about 1½d. a mile, excluding the driver. Milk is delivered once daily and empty bottles are collected at the same time. By using the wire crates the number of breakages is small, in spite of rough roads encountered in many parts of the round.

The question of having the herd tuberculin-tested and selling tuberculin-tested milk has often been considered, but has so far been ruled out as a practical commercial proposition, on account of the limited local market and high retail price for that milk.

For an average output of 40 gallons a day, the extra overhead charges for equipment, distribution and incidental expenses are well borne by the extra 1d. a gallon over the price obtained when milk is sold in bulk.

If milk is produced clean, and then sold in bulk to be bottled at a large centre, the extra cost must be shared by the wholesale buyer. Bottling is the only way milk can be delivered and kept clean. Dirty milk will not keep in bottles unless previously treated in some way. Why should anyone be content with

"treated" milk when the clean, fresh article is within the bounds of possibility? It is for the farmer to produce the article and convince the buyer of its merits.

The following table of costs is included to show how the 1d. per gallon increase in cost of production is made up:—

Extra Labour.	*Per week.*
Daily washing and grooming of cows: 2 hours ...	14 hr.
Special washing of cowsheds daily: ½ hour ...	3½ ,,
Limewashing cowsheds: weekly	1½ ,,
Scraping and cleaning cowsheds and cooling room: 4 hours per month	1 ,,
Sterilising of equipment daily: 1 hour	7 ,,
	27 hr.
27 hours at 8d. per hour	£0 18 0
Cost of coal and wood is 6d. per day. Total cost per week	0 3 6
	£1 1 6

This works out at an extra cost of 1d. per gallon on a daily output of 36 gallons (= 3s. per day, or 21s. per week). Much of the work included in the table of costs is obviously already required in any cowshed, so that a generous allowance is shown for the extra work.

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CHARLOCK SPRAYING IN DEVON.

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THE Seale-Hayne College has endeavoured to bring home, to the farmers of the district which it serves, the serious nature of a heavy growth of charlock in arable land and the practicability of spraying with copper sulphate as a remedy when the weed occurs in corn crops. A pamphlet, written by Mr. E. W. Fenton, M.A., B.Sc., was issued drawing attention to the detrimental effect of charlock on the corn crop and describing the various insect and fungoid pests which may attack crops and for which charlock acts as an intermediate host. The pamphlet was followed by a series of field demonstrations.

In 1922 two sets of small demonstration plots were laid down with the knapsack sprayer, and about five acres of corn was sprayed for a neighbouring farmer with the horse-drawn sprayer. In the following year 221 acres of corn were sprayed for farmers

in different parts of Mid-Devon and South Devon. This work was done with the horse-drawn sprayer, which was taken from place to place on a lorry. The farmers were charged for the copper sulphate used, but the College bore the cost of the lorry and other incidental expenses. In addition, sets of plots were also treated in the same year (1922) with the knapsack sprayer, including a series of plots to discover the best method of dealing with spurrey.

In the winter of 1923-1924, it was made known that the College would spray charlock for farmers within a 10-mile radius of the College, but would charge, in addition to the cost of the copper sulphate, 2s. per acre towards the cost of transporting the sprayer. A hundred acres of spraying were booked before the season commenced, but the spring and summer weather was so bad that only forty acres of this booked work could be done.

In 1925 the College has sprayed 200 acres on the same terms, of which 20 acres were spoilt by rain, the remainder being successful. In the course of carrying out this work certain points have been noticed which may be worthy of comment.

Treatment at Different Stages of Life.—The charlock plant may be said to have four stages in its life history, and the methods of eradicating the plant will vary with its age.

Stage I.—The seedling stage; the plant is a seedling showing two small cotyledons. In this stage it can be knocked out of the ground with a pair of light harrows.

Stage II.—The rosette stage; three or four rough leaves lie flat on the ground and in the centre is the bud which will later shoot up to form the stem. In this stage the root hold is firm enough to resist implements other than the horse-hoe, hand-hoe, or the cultivator. Spraying in this stage with the ordinary dose of 16 lb. of copper sulphate in 50 gallons of water per acre is also ineffective. The flat leaves are killed but the well protected bud escapes the spray and shoots up and bears its flowers, which later set seed.

There are two ways of dealing with the weed in this stage. A dressing of from 6 cwt. of fine ground kainit may be broadcast when the herbage is damp with dew; or it may be sprayed with 22 lb. to 25 lb. of copper sulphate in 50 gallons of water per acre.

Stage III.—The flowering stage; the plant stands about a foot high and has one or two branches bearing leaves and terminal yellow flowers.

In this stage the weed can be killed by spraying with 16 to 18 lb. of copper sulphate in 50 gallons of water per acre.

Stage IV.—The fruiting stage; in this stage the yellow flowers have given place to thick-walled pods which contain the numerous seeds. The only way to deal with charlock in this stage is to

pull, collect and burn it, as no spray will kill the seed, which is too well protected in the pod. In any case it is a mistake to let things get to this stage, because the corn will be far enough on to suffer quite seriously from the trampling of those who do the pulling.

The following cases are quoted to justify the statements made above.

A field was sprayed in April, 1923, in which the bulk of the charlock was in the rosette stage. At one end of the field there was half-an-acre of charlock which was flowering, and at the other end a rather larger area carried seedling charlock. The whole field, except a portion of the patch of seedling charlock, was sprayed with 16 lb. of copper sulphate in 50 gallons of water per acre. The flowering charlock died; the charlock in the earlier rosette stage recovered and flowered. Ten days after the spraying, the field was sown with grass seeds and was harrowed with seed harrows twice. None of the seedling charlock either on the sprayed or unsprayed areas survived: all of it was killed by the harrows.

In the same year another field of rosette charlock was sprayed with 16 lb. of copper sulphate per acre, and this, too, was a failure, as the charlock recovered and flowered. A set of plots was laid down in a field of rosette charlock, and doses of varying strengths were tried. It was found necessary to apply 22 lb. to 25 lb. of copper sulphate per acre in order to make a reasonably clean sweep of the charlock.

As a result, several acres of rosette charlock have been treated on the large scale, but only where the application per acre contained at least 22 lb. of copper sulphate to 50 gallons of water have the results been satisfactory. Where a lighter dressing was applied the yellow colouring in the field later on was sufficient to make the farmer dissatisfied at being charged for the work.

On 29th May, 1924, Mr. Crisp (District Lecturer for South Devon) broadcast 3 cwt. of fine ground kainit on half an acre of very thick rosette charlock. The work was done early in the morning while the plants were still dewy, and the weather remained fine until the following day. On 6th June, 1924, when the charlock was flowering, the remainder of the field was sprayed at the rate of 18 lb. of copper sulphate in 50 gallons of water per acre. On 14th June the field was inspected. On the two plots the results were very similar, the bulk of the charlock having been killed. The corn had recovered on the kainit plot but was still showing the effect of the spray on the remainder

of the field. On 21st June a little charlock had recovered on the kainit plot, the rest of the field being practically clear. The corn appeared to have completely recovered.

Spraying with sulphate of ammonia solution has been attempted three times with the knapsack and once with the horse-drawn sprayer. In each case it was found that, on flowering charlock, 1 cwt. of sulphate of ammonia in 50 gallons was insufficient, and that only when 2 cwt. of sulphate of ammonia in 50 gallons of water were applied per acre to flowering charlock was an effect produced which was at all comparable to the result of the usual dressing of copper sulphate.

In 1922 some charlock was sprayed when forming pods. The crop was cut in the autumn, but for some time wet weather prevented its being carried. The farmer wanted to plough the stubble, and in order to clear the ground the corn was carted away and stood up in shocks on a square patch in the middle of a neighbouring lea field. When this lea field was ploughed the fact that the spraying had not affected the seeds in the pods was demonstrated by a clearly marked patch of very thick charlock in the ensuing corn crop.

During 1925 further plots have been laid down with a view to ascertaining what effect was produced on the yield of corn by spraying with copper sulphate or by broadcasting kainit.

A set of plots, each plot being 1/40th acre in area, was laid out in triplicate on a crop of winter wheat. The crop had been well manured, but there was a heavy growth of charlock. The spraying was carried out at the rate of 16 lb. per acre in 50 gallons of water when the charlock was flowering, the plots being harvested by hand and weighed. The results were as follows :—

Plot.	*Treatment.*	*Grain, bus. per acre.*	*Straw, cwt. per acre.*
1	Sprayed	41	$26\frac{1}{4}$
4	Sprayed	37	$23\frac{1}{4}$
7	Sprayed	38	$23\frac{1}{4}$
	Average sprayed	$38\frac{2}{3}$	$24\frac{1}{4}$
3	Unsprayed	39	$26\frac{1}{2}$
6	Unsprayed	37	$24\frac{3}{4}$
9	Unsprayed	36	$20\frac{1}{4}$
	Average unsprayed	$37\frac{1}{3}$	$23\frac{5}{6}$

It is, therefore, possible to say that in this case spraying neither decreased nor increased the yield of corn. The sole advantage reaped from the spraying was that a heavy crop of charlock had been prevented from setting seed.

With these plots it was not possible to compare the effect of kainit as the charlock had gone too far, but another set of plots was laid out on rosette charlock. In this second case the crop was spring oats, the field being very weedy. Large numbers of other weeds were present besides a heavy growth of charlock, and the soil was in low condition. The set of plots was laid out in the form of a square, and from inspection of the plots during growth, and from the yields, it was deemed necessary, because of damage done by rabbits, to discard the results from Plots 1, 2, 5 and 6, forming the corner of the square nearest a copse which bordered the field. The results, however, from the remaining plots are fairly uniform and show points of interest.

The average yield of two control plots—the results from the third (Plot 5) being discarded—was $34\frac{1}{4}$ bushels of grain and $16\frac{1}{2}$ cwt. of straw per acre, the poor condition of the soil being indicated in this result.

The three kainit plots gave an average yield of $35\frac{1}{2}$ bushels of grain, and $17\frac{7}{12}$ cwt. of straw per acre. Six cwt. of kainit per acre were broadcast when the charlock was in the rosette stage, roughly, 95 per cent. of the charlock present being killed and no noticeable increase or decrease of yield occurring.

Of the plots sprayed at the rate of 22 lb. of copper sulphate in 50 gallons of water per acre, the results in one case (Plot 2) were discarded; the other two gave an average yield of $37\frac{5}{8}$ bushels of grain, and $17\frac{3}{8}$ cwt. of straw per acre. In this case, despite the heavy dose of copper sulphate, there was no decrease in the yield.

Three plots were sprayed at the rate of 16 lb. of copper sulphate in 50 gallons of water when the charlock was flowering. Two of the plots (Nos. 1 and 6) were damaged by rabbits and their results discarded, while the third gave the low yield of 27 bushels of grain, and $12\frac{3}{4}$ cwt. of straw per acre. This result is not a very reliable one, but it is possible that while no harm is done by spraying a healthy crop, a crop in poor heart may suffer from late spraying when the charlock is flowering.

Spraying Costs per Acre.—The use of a horse-drawn mechanical sprayer required the following gang to keep it at work:—

Cost of Horse Sprayer.

	s.	d.
To draw and drive the sprayer—		
1 horse at 4s. 6d. per day	4	6
1 man at 5s. 0d. per day	5	0
To draw water 1 man and 1 horse	9	6
	19	0

	s.	d.
Cost per day for horse and man labour	19	0
(They should spray 10 acres per day.)		
Cost of horses and men per acre	1	11
Depreciation, repairs, etc. (on £30 sprayer) per acre	0	6
Cost per acre for use of sprayer	2	5

Spraying with Copper Sulphate.

	s.	d.
Use of sprayer per acre	2	5
16 lb. copper sulphate at 4d. per lb.	5	4
	7	9

Spraying with Sulphate of Ammonia.

	£	s.	d.
Use of sprayer per acre	0	2	5
2 cwt. of sulphate of ammonia at 12s. 3d. per cwt.	1	4	6
	1	6	11

Cost of Broadcasting Kainit.—The best method is to broadcast 3 cwt. per acre across the field and then 3 cwt. per acre up and down the field. In this way an acre will take about 2 hours.

	s.	d.
Labour per acre (2/8ths of a day at 5s. 0d.)	1	3
6 cwt. kainit (finely ground) at 3s. 0d.	18	0
	19	3
One-half of the kainit will remain to benefit following crops, therefore—		
Gross cost per acre	19	3
Deduct for residual manurial value 3 cwt. kainit at 2s. 9d.	8	3
	11	0
Net cost per acre of broadcasting kainit when the price is £3 per ton	11	0

(In this estimate it is necessary to allow for finely ground kainit a higher figure than the market price of ordinary kainit.)

Conclusions on Costings.—In the light of the experience gathered it is not considered advisable to use sulphate of ammonia for spraying corn crops to kill charlock for these reasons:—

1. The cost per acre is much too high.
2. The dissolving of a large bulk like 2 cwt. of sulphate of ammonia into 50 gallons of water is tedious, and in consequence the work cannot be done so quickly.

3. It is too risky a proceeding to apply 2 cwt. of sulphate of ammonia to a corn crop. On a crop of malting barley it is distinctly bad practice, and on a crop that has had a reasonable dose of nitrogen in the spring, it is asking for trouble at harvest time.

When charlock is in the rosette stage there is a choice of using fine ground kainit broadcast at 6 cwt. per acre, or of spraying with 22 lb. of copper sulphate in 50 gallons of water per acre.

The former method will cost about 11s. per acre, as shown above, while the cost of the latter will work out as follows:—

	s.	d.
Use of sprayer per acre	2	5
22 lb. of copper sulphate at 4d. per lb.	7	4
	9	9
Cost of spraying per acre with 22 lb. of copper sulphate in 50 gallons of water	9	9

The difference in cost is not of any great importance as long as fine ground kainit is £3 a ton and copper sulphate 4d. a lb.

Spraying entails the purchase and use of a sprayer, whereas no apparatus is needed for broadcasting. The broadcasting must be done between dawn and nine o'clock in the morning, but spraying can start at nine in the morning and need not be stopped until the evening.

If spraying is spoilt by rain a second dose means a useless expenditure of 9s. 9d. and little else; but if broadcasting kainit is upset in the same way, there is a useless expenditure of 11s., and there is also that fact that should the dose be repeated, the crop will receive 12 cwt. per acre of kainit. Where 20 acres of corn are concerned this represents no mean bill for hauling; and there is also the question whether it is possible to overfeed a soil with kainit. In the ordinary rotation the soil will receive perhaps 4 or 5 cwt. of kainit per acre as a dressing for the root crop. Where finely ground kainit is used to kill charlock in the corn, the soil may receive 12 cwt., where two straw crops are taken, and 18 cwt. per acre where three straws are taken in the rotation.

Effect on Grass Seeds and Legumes.—No evidence has come to light that any real harm has ever been done to the young grass and clover, when spraying has been carried out on corn which was seeded down. Besides the many cases under direct observation, many more acres were sprayed by the College for

farmers, yet there has never been a complaint that the grass seeds have been damaged.

On one occasion the sprayer was driven across a piece of peas and oats, and on another occasion it was taken across some silage mixtures which were growing in plots. In the latter case vetches and beans received the spray. The peas, vetches, and beans in each case were slightly damaged, but were not killed; in fact after a lapse of three weeks or a month it was very difficult to tell where the sprayer had crossed the plots. The matter needs further trial, but it is probably safe to say that vetches and peas will take no great harm from a spray of 16 lb. of copper sulphate per acre.

It is also reasonable to deduce that where grass seeds sown in corn are concerned the grasses will take no harm, for if the corn can stand the spray the grass, which is a similar plant and has the advantage of being partially protected by the corn, will also take no harm from the spray. The clovers at the time of spraying will, in any case, be very young and have considerable protection, and will recover from any slight damage that may overtake them.

Weather.—The length of time that may elapse after the spraying is finished, and before rain will spoil its effect, may be gathered from the following instances:—

Two fields were sprayed on different days, both were cases of flowering charlock in oats, both were treated with 16 lb. of copper sulphate in 50 gallons of water per acre, both were sprayed in dull thundery weather, and both were finished between 4 o'clock and 5 o'clock in the evening. One had rain at 6.30 a.m. the following day and was a failure, the other had heavy rain at 5.30 p.m. the following day and was a complete success.

Care of the Sprayer.—The two important points in spraying are to make the sprayer deliver a fine mist, and to put on the right quantity of copper sulphate per acre. The maintenance of a fine mist depends on keeping the nozzles and pipes clear, keeping the pump in good working order, and in the case of a mechanical sprayer, using a horse that moves along steadily at a good walking pace. It is useless to allow the sprayer to lie in a dirty part of the barn throughout the winter and then expect to be able to take it straight out into the field and do good spraying with it. Experience shows that this warning is neither obvious nor needless. Good work can only be done by starting with a thoroughly clean machine, and preventing choking by making everything that goes into the barrel of the sprayer pass through fine muslin.

On most sprayers the pump itself will be well constructed and will stand a good deal of wear, but sometimes it is necessary to renew the leathers on the piston or to provide new actuating links, etc. On mechanical sprayers there is an overflow valve which permits surplus liquid to be pumped back into the barrel. A weak spray is sometimes due to a weakness in the spring in this valve which allows liquid to pass back into the barrel instead of being forced down to the nozzles. It is a wise proceeding to pace out pretty frequently the actual area covered by the sprayer in emptying its barrel. This acts as a check on the actual dose of copper sulphate which is being applied per acre, and also is an indication of the efficient working of the pump.

A variation in the area covered may indicate trouble in the pump, or it may be due to leakages in the barrel or in the many joints between the pump and nozzles. It is obviously important to know what the sprayer is doing. Supposing that 16 lb. of copper sulphate are dissolved into the barrel, and that it should empty once to the acre. Through some defect the barrel may empty itself when only $\frac{3}{4}$ of an acre has been covered. Thus over a 10-acre field, 71s. worth of copper sulphate is being used instead of 53s. worth, and although this will certainly kill the charlock the corn is having rougher treatment than is necessary. Should the barrel discharge its 16 lb. over $1\frac{1}{4}$ acres, the charlock is only getting $12\frac{3}{4}$ lb. of copper sulphate per acre—an inadequate dressing.

An instance of the advantage of a finer spray was very well shown where two neighbouring fields belonging to different farmers were sprayed on the same day. The first farmer provided a very sluggish horse to draw the sprayer, while the second one provided a horse which was prevented with difficulty from taking the sprayer about the field at a trot. On the latter field the charlock died away after spraying much more rapidly than on the field where the pump had worked more slowly even though the dose per acre was the same.

In conclusion, it is desired to acknowledge the assistance given in these experiments by Mr. A. Noble, N.D.A., of the College Staff, Messrs. W. C. Crisp and R. P. Hawkins, B.Sc., District Lecturers for the Devon County Council, and also by students of the College.

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THE VALUE OF THE MINERALS IN FISH MEAL FOR FATTENING PIGS.

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BEFORE 1916 fish meal was not used to any extent in Great Britain for feeding farm animals, although previous to that time considerable quantities were manufactured in this country and exported to the Continent. When the restrictions due to the War brought it on to the market as one of the few available concentrated foods for live stock its value was speedily recognised by agricultural colleges who tested it. As soon as it was recognised to be a valuable feeding stuff, especially for young growing stock, its consumption rapidly increased and many farmers began to use it indiscriminately.

The three most important constituents of fish meal are protein or albuminoids, mineral matter (mostly phosphate of lime and salt) and oil. The cereal grains and starchy roots on which pigs are mostly fed are recognised to be deficient in certain minerals and in some cases in protein. Fish meal, which is rich in animal protein and also in mineral elements in the proportion in which they occur in animal tissues is therefore a naturally mixed supplement to such foods. But fish meal is, rightly or wrongly, out of favour with many of the farmer's customers, and further, as there is not sufficient available and the price is consequently high it seems desirable to find a suitable substitute, and that was the general object of the present investigation. The particular object of the experiment reported here was to determine the value for fattening bacon pigs of the mineral matter which is one of the two chief constituents of fish meal.

1. **Plan of Feeding.**—In order to obtain information on this point a scheme of rations was drawn up in which one pen got a basal mixture of cereal grains plus 10 per cent. of fish meal, on which ration it was known that pigs would grow and fatten well. In another pen the same basal mixture of cereals was used alone without fish meal. The difference between these two pens would show the result due to all the variable constituents combined in fish meal. Finally, to determine how much of the value of fish meal was due to the minerals which it supplied, a third ration was designed to include the same basal ration as before with the addition of a mixture of inorganic salts containing mineral elements believed to be deficient

in the cereal ration. The rations for the three pens were therefore as follows:—

Pen No. 1.	*Pen No. 2.*	*Pen No. 3.*
Basal	Basal + Mineral Mixture	Basal + Fish Meal

The following table shows the composition of these rations :—

TABLE I.—COMPOSITION OF RATIONS EMPLOYED.

Ingredient.	Pen No. 1.		Pen No. 2.		Pen No. 3.	
	Parts.	Percentage.	Parts.	Percentage.	Parts.	Percentage.
Barley	60	33.3	60	32.8	60	30.0
Middlings ...	80	44.4	80	43.7	80	40.0
Maize Meal ...	40	22.2	40	21.8	40	20.0
Fish Meal ...	—	—	—	—	20	10.0
Mineral Mixture	—	—	3	1.6	—	—

The mineral mixture which was used had the following composition :—

Ground Chalk	300	parts.
Common Salt	300	,,
Iron Oxide (Fe_2O_3)	30	,,
Potassium Iodide	1	,,

2. **Pigs.**—The pigs employed in the experiment were all pedigree Large Whites bred on the Cambridge University Farm. There were only sufficient pigs available to permit of seven in each pen. The pens were arranged so as to be comparable as regards weight and sex, and five out of the seven in each pen were also comparable as regards breeding. Table II gives particulars of the pens at the beginning of the experiment.

TABLE II.—DETAILS OF PENS AT BEGINNING OF EXPERIMENT ON 30TH JANUARY, 1925.

	No. 1.	No. 2.	No. 3.
Average age ...	118 days	124 days	122 days
Average weight...	71.0 lb.	71.9 lb.	71.7 lb.
Hogs	4.0	4.0	4.0
Gilts	3.0	3.0	3.0

3. **Feeding.**—All pens were given as much food as they would clean up. The meal was mixed in wooden tubs with twice its weight of water and mixing was done once a day at

about 10 a.m. Two meals per day were given and water was always available for drinking.

4. **Weighing.**—At the commencement of the experiment the pigs were weighed once per week, at 7.0 a.m. on Fridays. Towards the end they were weighed at the same time on three successive days, Thursday, Friday and Saturday, and the average was taken as the weight on Friday.

RESULTS.

1. **Live Weight Gain and Food Consumption.**—For the first two weeks, none of the pigs in Pens 1, 2 and 3 gained much weight and they were all irregular in their feeding. At the end of that period they appeared to have settled down to their new conditions. Pen 2, on cereals plus mineral mixture, and Pen 3, on cereals plus fish meal, remained healthy to the end of the experiment with the exception of one pig in Pen 2 which had to be removed on account of illness at the end of the seventh week. Pen 1, on the other hand, which was receiving the basal ration of cereals only, made much slower growth and the pigs in it developed many of the symptoms associated with a deficient diet. Several of them became very "crampy" and weak and had to be removed during the course of the experiment. For this reason it was not possible to obtain average figures for live weight increase and food consumption comparable to those for Pens 2 and 3, but the probable average gain for the pen has been estimated from the figures for the three pigs which remained till the end of the experiment and this is shown in Fig. 1 compared with the actual figures for Pens 2 and 3. In Table III are shown the details of live weight increase and of the food consumed by these two pens.

It will be seen from the table that over the whole period of 12 weeks Pen No. 2 gained a total of 654.0 lb. and consumed 3003.0 lb. of meal, giving a production of 1 lb. live weight gain for 4.6 lb. meal.

On the same period Pen No. 3 gained a total of 841.5 lb. for 3354.25 lb. meal or 1 lb. live weight gain for 3.99 lb. of meal.

2. **Carcass Dressing Percentage.**—Only four pigs from each of Pens 2 and 3 were heavy enough to send to the St. Edmundsbury Co-operative Bacon Factory at Elmswell. Table IV shows the details of live and dead weights.

TABLE III.—LIVE WEIGHT GAIN AND FOOD CONSUMPTION OF PEN 2 AND PEN 3.

Pen No. 2.

Week ending.	*No. of Pigs.*	*Average Live Weight.* lb.	*Average Food consumed.* lb.	*Average gain.* lb.
6 Feb.	7	74.43	24.4	2.57
13 Feb.	7	77.71	21.7	3 99
20 Feb.	7	84.14	30.1	6.43
27 Feb.	7	92.96	31.8	8.81
6 Mar.	7	98.64	34.3	5.69
13 Mar.	7	105.86	35.3	7.21
20 Mar.	7	115 96	38.3	10.10
27 Mar.	6	126.66	44.5	9.13
3 April	6	138.63	17.7	11.97
10 April	6	150.8	46.5	12.17
17 April	6	164.00	51.7	13.20
24 April	6	175.08	55.0	11.05

Pen No 3.

Week ending.	*No. of Pigs.*	*Average Live Weight.* lb.	*Average Food consumed.* lb.	*Average gain.* lb.
6 Feb.	7	72.57	23.6	1.86
13 Feb.	7	80.14	23.9	7.57
20 Feb.	7	87.71	30.1	7.57
27 Feb.	7	97.03	31.8	9.31
6 Mar.	7	108.07	34.9	11.04
13 Mar.	7	119.93	39.1	11.86
20 Mar.	7	133.74	44.9	13.81
27 Mar.	7	142.46	45.6	8.71
3 April	7	156.51	49.9	14.06
10 April	7	169.10	52.6	12.50
17 April	7	180.36	51.1	11.3
24 April	7	190.93	51.1	10.57

TABLE IV.—DETAILS OF SLAUGHTER OF PENS 2 AND 3.

	Pig No.	*Fasted Live Weight.* lb.	*Carcass Weight.* lb.	*Dressing percentage.*
Pen No. 2.				
	159	194.5	145	74.5
	166	200.0	149	74.5
	168	217.0	165	71.9
	180	211.5	152	71.9
	Average	205.75	150.5	73.2
Pen No. 3.				
	157	222.0	152	68.5
	160	254.0	188	74.0
	176	244.0	178	72.9
	171	206.0	148	70.5
	Average	231.5	165.75	71.5

From these figures it will be seen that the average carcass dressing percentage is not high in either case, but is specially low in the case of Pen 3. It should be noticed, therefore, that though the fish meal pen made a live weight gain of 1 lb. for a smaller consumption of meal than the pen getting the mineral supplement the actual production of carcass was not equally high and a rough estimate indicates that just over

$8\frac{1}{4}$ lb. of meal were required to produce 1 lb. of carcass in each case.

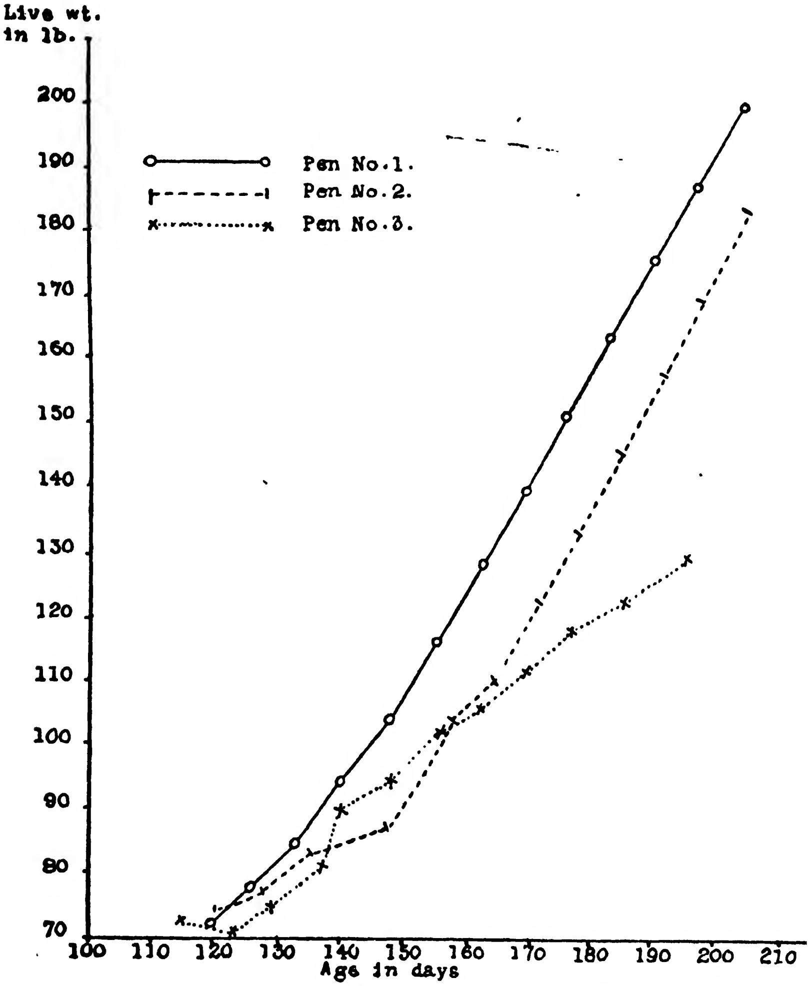

FIG. 1.—Live Weight Increase of Animals in Pens Nos. 1, 2 and 3.

3. **Growth.**—Pen No. 2 although growing well all the time developed shorter and lower frames than No. 3, but appeared to be better fleshed. No. 3 on the other hand grew long tall frames and appeared thinner and less well fleshed than No. 2.

4. **Health.**—No. 1 came very far behind the other two in general condition and as already mentioned showed many signs of a deficient nutrition. An abnormal craving, or " Pica " as this symptom is termed, was present especially in the later stages and led to the pigs in this pen spending nearly all their

time licking the whitewashed walls of the sty in an attempt to get more lime than was supplied in their food. This licking was so persistent that the animals frothed at the mouth and the walls and floors became flecked with the froth. A very "crampy" condition also appeared which led to the removal of most pigs from this pen, and the other prominent symptom was the rough and dirty skin which most pigs showed.

Pen No. 2 came next in general liveliness, but was distinctly less frisky that No. 3. The coats, however, were exceptionally clean and bright and for this reason the pen looked the best of all at first sight.

Pen No. 3 was outstandingly the most lively pen of all and the pigs appeared as frisky as if they had been on grass, The skins of this pen, however, remained coarse and dirty all through the experiment.

Discussion of Results.—The experiment confirms the results of previous work carried out by Evvard (1) and others in America and by Orr and Crichton (2) at the Rowett Institute, Aberdeen, showing that cereals alone do not supply all the food requirements of the pig. It also indicates that a large part of the value of fish meal for growth lies in the minerals it supplies, for when a substitute for these alone is added to cereals the total growth, as shown in Fig. 1, is not very much less than where fish meal is employed. After the pigs were approximately 100 lb. live weight the rate of growth was as great with a mineral supplement only as it was with the addition of fish meal.

Finally, it should be noted that the value of a salt mixture depends upon the composition of the ration to which it is added and on the requirements of the animal to which the ration is being given. The value of the mineral supplement used in this experiment lay in the fact that it supplied approximately the difference between the mineral elements required by the pig and those which are supplied in the basal ration rather than that it possessed any magical virtue of its own.

The experiment was carried out by the writer under the general direction of Professor T. B. Wood, F.R.S., to whom he is indebted for information and help. In conclusion, it should be noted that no practical recommendations can as yet be based on the results of these experiments, which, as previously stated, form part of an extended scheme of research work that is now in progress.

REFERENCES.

1. Evvard: "Iowa Experiment Station, Circ. No. 70." Dec., 1922.
2. Orr and Crichton: "The Scottish Journal of Agriculture." Vol. V, p. 146.

A DORSETSHIRE EXPERIMENT WITH STRAWBERRY CLOVER.

MARTIN H. F. SUTTON, F.L.S.

BOTANICALLY Strawberry Clover (*Trifolium fragiferum*) is somewhat similar to White Dutch Clover. It is capable of spreading and establishing itself by its stout creeping runners and roots. The flowers are pink and the flower-heads closely resemble the fruiting strawberry in appearance; the calyx, after flowering, becomes much inflated. The plant is said to be general in England, Ireland and southern Scotland; some authorities state it is frequently found in rather dry meadows and pastures. On the dry gravel at Reading and the heavier ground at Slough it has, experimentally, done equally well, thus proving its adaptability for varied soil conditions. There is no doubt, however, it delights in ground much wetter than suits most clovers; it spreads over humid pastures most readily and has a capacity for covering the ground with a thick, close herbage.

The remarkable results in improving the value of land (an acre worth £5 is now reported worth £20 by many competent farmers) by its use during recent years in Australia and New Zealand on swampy, wet, heavy ground near the sea-coast, where, generally speaking, only coarse grasses, reeds and other herbage possessing no fodder value succeed, led to an experiment in England with precisely the same object in view, viz., that of increasing the grazing value of this particular type of land of which many thousands of acres exist in the British Isles. The success of the experiment is already assured, though it must be admitted that the Strawberry Clover has not spread so rapidly here as it is said to do in Australia and New Zealand; this may be due to climatic or other conditions. In those countries Strawberry Clover is termed "everlasting" on account of its habit of propagating itself by its creeping roots and reseeding.

Following various inquiries a very suitable strip of land answering the required description was discovered in Dorsetshire on the south bank of the river Frome which outfalls into Wareham (Poole) Harbour a short distance away. Owing to limitation of seed supply and other conditions, an area half-an-acre in extent only was available.

The land is typically sea-washed ground, soft, containing poor herbage composed of rush and sedge grass. It is occasionally flooded, especially at high tide during autumn, and sometimes remains under water in the early spring for six

weeks. On this turf dairy cows are turned out to graze at certain periods of the year—late spring, summer and early autumn. The preparatory work for the experiment consisted of enclosing the selected area at both ends (thus preventing ingress of cattle). The existing coarse herbage was scythed off as closely as possible and hillocks were reduced to moderate dimensions and bush-harrowed. It will be understood that spike-harrowing and rolling such soft treacherous ground are altogether impracticable. The seed was broadcast on 18th May, 1923, bush-harrowed twice and allowed to take its chance.

The months of June, July and August of 1924 proved so wet that it was impossible to mow or graze, with the result that a dense swampy growth of grass (more or less innutritious) abounded. A thorough and systematic examination of the plot about the middle of August that year—fifteen months after sowing—revealed the highly gratifying fact that the Strawberry Clover was successfully competing with the surrounding herbage; in places the clover was abundant, creeping strongly and bearing flower-heads standing well above the herbage. Later in the year the herbage was mown and lightly fed by cows.

Since the early summer of the present year (1925) the experimental area has been continuously grazed and the cows are eating the herbage with relish. The inclusion of the Strawberry Clover has sweetened the grazing. A second inspection of the plot in August (rather more than two years after sowing) showed that the Strawberry Clover is fast making headway and very successfully invading the indigenous herbage. Although, as mentioned in the second paragraph, the clover has spread somewhat more slowly here than in Australia and New Zealand, there is every hope that a practical method has been found for the improvement, by the use of Strawberry Clover, of the type of land described. An interesting point is that constant and prolonged flooding by sea-water does not appear to injure the plant in any way and that close grazing encourages its development. There would seem, therefore, to be a reasonable prospect that useless swamps and waste marshland may be converted into useful and profitable grazing areas by this means.

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ARTIFICIAL LIGHTING OF POULTRY HOUSES.

E. T. BROWN.

AN article in the September, 1924, issue of this *Journal* dealt with the artificial lighting of laying houses during the winter evenings. The object of such lighting is to increase the rate of production at a time of year when the retail price of eggs is high, and certain factors were indicated as of importance if the plan were to prove satisfactory. By actual experience in working during the past few years the writer has found that the results fully justified the initial expense of installing lights in the sheds and the slight extra amount of labour entailed in attending to the birds after dark. No comparative tests had, however, been made in connection with the system; hence it was then impossible to write in detail concerning the exact influence of the prolonged day during the winter upon the fecundity of the birds.

To make good this omission 96 pullets were selected in September, 1924, divided between two exactly similar houses and runs and tested one flock against the other from 1st October, 1924, to 29th September, 1925. The birds selected were Light Sussex, and the whole 96 were hatched on 10th and 11th March, 1924. They were well-grown, forward birds, similar to those which usually prove to be the most prolific winter layers. The division of the birds was done indiscriminately and without giving preference as to growth and development to either flock, and both flocks were managed in exactly the same manner throughout the 52 weeks, excepting that in one case the house was artificially lighted for an hour and a half each evening from 8th October until 24th March and a small scratch feed was supplied at the time.

Type of House.—The houses used for the experiment each measured 24 ft. by 14 ft., and were of the open-fronted type. The upper half of the front was filled in with small mesh netting, being protected by a reversible shutter 2½ ft. in width. The shutter was so designed that it could be used for protective purposes during bad weather, being fixed at an angle of 45 degrees from the top, but reversed to an angle of 45 degrees from a point half-way up the open section so as to allow the rays of the sun to penetrate into the interior of the house in fine weather. The sheds were constructed of 1-in. tongued and grooved matching, with felt covering to the roofs. The

floor was made of ashes and tar on a foundation of clinkers and raised 4 in. above the level of the surrounding ground. The perches were placed at right angles from the back wall, raised 22 in. above the floor, with a droppings-board 4 in. below. The nest boxes, dry mash hoppers, water vessels and grit, charcoal and oyster shell boxes, were all raised 18 in., so that the whole of the floor space was available for scratching. Each bird was allowed 7 sq. ft. of floor space. Each grass run was approximately a quarter of an acre in extent, this being sufficiently large to ensure a good herbage throughout the twelve months. The sheds were surrounded on three sides by 12-ft. wide strips laid down in ashes and tar, these being swept daily and the droppings removed.

System of Lighting Employed.—Much of the success of the system depends upon the brilliancy of the lights employed. Ordinary oil lamps are of very little use, as the birds are not encouraged by the semi-darkness to leave their perches, while at the same time there is not sufficient illumination to enable the birds to find the grains of corn in the floor litter. Petrol-burning lamps fitted with incandescent mantles are excellent for the purpose, and acetylene may also be used, provided a sufficient number of burners be placed about the shed and efficient reflectors are fitted. When available, however, electric light is undoubtedly the finest illuminant. For the purpose of the experiment under review the house supply of current was tapped and two 50 candle-power lamps were suspended 5 ft. from the floor and in addition two 5 candle-power lamps were employed as dimmers. The large-powered lamps were kept burning from 8.30 p.m. to 9.55 p.m., when the dimmers were automatically brought into play; the latter being suspended 2½ ft. above the perches and only used for five minutes each evening to enable the birds to find their roosts after the main power was switched off. A simple home-made clockwork arrangement was all that was required for turning off the lamps at the appointed times.

System of Feeding.—As it was deemed necessary to estimate the daily consumption of food throughout the period of the test the dry mash and grain system of feeding was adopted. This system gives more reliable data concerning consumption, and there is little danger of the birds over-eating, as the dry mash is not sufficiently palatable. The grain ration was supplied three times a day, namely, a quarter first thing in the morning, a quarter at mid-day and the remainder an hour and a half before the normal time for the birds to go to roost, but

never later than 7 p.m. in summer. The dry mash hoppers were kept open all the time; hence the birds could feed as they wanted. Green food, consisting of onions, swedes, carrots, chopped nettles, lawn grass, cabbages and green clover was supplied daily at noon, the allowance being at the rate of about ¾ oz. per bird per day. Fresh water, grit, oyster shell and granulated vegetable charcoal were always before the birds. No charge is entered in the feeding account for green food, as it was all garden surplus.

During the period when the test house was lighted at night an extra feed of grain was provided, this amounting to ⅓ oz. per bird per day. This was additional to the 2 oz. of grain provided during the day in the three meals mentioned above. The allowance of grain for both pens for the first 28 weeks was 6 lb. a day; for the last 24 weeks 5 lb. a day. The quantity of mash consumed varied according to the rate of production and the time of year, but an interesting point, worthy of note, is that the heaviest layers in the tested flock made use of the dry mash hopper during the evening in addition to the ⅓ oz. of grain supplied, thus indicating the need for giving heavy layers more opportunity for eating during the short winter days.

The grain ration during the 28 winter weeks consisted of equal parts of wheat and oats, with a half part of kibbled maize; the same mixture being used for the evening scratch feed. The cost of this for the whole twelve months was 13s. 6d. per cwt. The mash mixture varied somewhat at times, but all changes were made gradually; the ingredients consisted of middlings, broad bran, Sussex ground oats, maize gluten feed, and meat and bone meal during the winter, with a little bean meal introduced during the warmer months. The cost of the mash for the whole period was 12s. per cwt. The feeding was not in any way forcing; just the ordinary rations that would be supplied by the average poultry-keeper desirous of securing a large number of eggs without stimulating the birds unduly.

Cost of Feeding.—The following table gives the relative cost of feeding the two flocks:—

Period.	*Foods.*	*Test Flock.*	£	s.	d.	*Control Flock.*	£	s.	d.
1st Oct. to 14th April	Grain	10½ cwt.	7	1	9	10½ cwt.	7	1	9
		1½ cwt.	1	0	3				
	Dry mash	11¾ cwt.	7	1	0	10½ cwt.	6	6	0
15th April to 29th Sept.	Grain	7½ cwt.	5	1	3	7½ cwt.	5	1	3
	Dry mash	9 cwt.	5	8	0	9¾ cwt.	5	17	0
			£25	12	3		£24	6	0

The cost of feeding the test flock amounted to 10s. 8d. per bird; for the control flock 10s. 1¼d. per bird.

Production.—The eggs were sold locally at the ruling market price; the figures entered, therefore, in the following tables regarding value of eggs per dozen is only approximate. For the purpose of the test the 52 weeks were divided into thirteen periods of 4 weeks each, the following tables being given in accordance with this plan:—

TEST FLOCK.

Period.	*Total Number of Eggs.*	*Average per bird.*	*Approx. Value per doz.*	*Total received for eggs.* £ s. d.
1st Oct. —28th Oct. ...	808	16¾	@ 3/-	10 2 0
29th Oct. —25th Nov. ...	1,032	21½	,, 3/6	15 1 0
26th Nov. —24th Dec. ...	1,107	23	,, 3/-	13 16 9
25th Dec. —20th Jan. ...	1,104	23	,, 2/7	11 17 9
21st Jan. —17th Feb. ...	1,153	24	,, 2/4	11 4 3
18th Feb. —17th Mar. ...	1,031	21½	,, 1/10	7 17 6
18th Mar. —14th April ...	920	19	,, 1/3	4 15 9
15th April—12th May ...	665	13¾	,, 1/2	3 4 9
13th May —9th June ...	584	12	,, 1/5	3 8 9
10th June —7th July ...	521	10¾	,, 1/8	3 12 6
8th July —4th Aug. ...	511	10¾	,, 2/-	4 5 3
5th Aug. —1st Sept. ...	417	8¾	,, 2/3	3 18 6
2nd Sept. —29th Sept. ...	433	9	,, 2/6	4 10 3
	10,286			£97 15 0

Total number of eggs	10,286
Average number of eggs	214¼
Total value of eggs	£97 15s. 0d.
Average value of eggs	£2 0s. 8¾d.
Cost of Feeding	10s 8d.
Percentage of First Grade eggs	98 76

CONTROL FLOCK.

Period.	*Total Number of eggs.*	*Average per bird.*	*Approx. Value per doz.*	*Total received for eggs.* £ s. d.
1st Oct. —28th Oct.	128	2¾	@ 3/-	1 12 0
29th Oct. —25th Nov.	655	13½	, 3/6	9 11 0
26th Nov.—24th Dec.	867	18	,, 3/-	10 16 9
25th Dec. —20th Jan.	903	18¾	,, 2/7	9 14 6
21st Jan. —17th Feb.	934	19½	,, 2/4	9 1 6
18th Feb.—17th Mar.	985	20½	,, 1/10	7 10 6
18th Mar.—14th Apr.	812	16¾	,, 1/3	4 4 6
15th Apr.—12th May	809	16¾	,, 1/2	3 18 9
13th May — 9th June	857	17¾	,, 1/5	5 1 6
10th June— 7th July	766	16	,, 1/8	5 6 3
8th July — 4th Aug.	681	14¼	,, 2/-	5 13 6
5th Aug.— 1st Sept.	703	14¾	,, 2/3	6 11 9
2nd Sept.—29th Sept.	604	12½	,, 2/6	6 5 9
	9,704			£85 8 3

Total Number of Eggs	**9,704**
Average Number of Eggs	**202**
Total Value of Eggs...	**£85 8 3**
Average Value of Eggs	**£1 15 7**
Cost of Feeding	**£0 10 1¼**
Percentage of First Grade Eggs	**98.1**

Conclusions.—The results of the experiment show that:—

1. The effect of lighting the house is *to increase the output of eggs during the winter*, as the average number of eggs laid by the test flock during the first 12 weeks was 61¼, as against 34¾ laid by the control flock.

2. The *annual* production is only slightly increased; in this case by 12¼ eggs per bird.

3. That the cost of the additional feed amounted to 6¼d. for the year, whereas the increase in egg value was 5s. 1¾d. per bird; an increase in gross return which is more than sufficient to pay for the extra cost of labour and lighting.

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THE COMPILING OF BALANCED PRODUCTION RATIONS.

J. HUNTER-SMITH, B.Sc., and H. W. GARDNER, B.A., Dip. Agric. (Cantab.),
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IN the September issue of this *Journal*, an article was published describing a simple table which could be of permanent service as a guide to the economical purchase of concentrated feeding stuffs. The present article describes how the same table can be used for the purpose of combining foods, whether home-grown or purchased, to give balanced rations for cows in milk.

Why is so much emphasis placed on the desirability of using "balanced" rations for all classes of stock? Firstly, because it is sound scientifically; and secondly, because it agrees very closely with the system practised by the most successful stock farmers.

In the case of dairy cows, the following reasons may be urged, from a practical standpoint, in favour of the balanced ration:—

(*a*) That by means of it the cows are maintained continuously in good health.

(*b*) That it will secure, year after year, the maximum yield from each cow.

(*c*) That in addition to these results, a strict control is kept over feeding costs.

These, it will be admitted, are vital considerations, and any simple method which shows how to make up balanced rations without going to lengthy arithmetical calculations should meet with a warm welcome.

It must be emphasised at the outset that every farmer has to compile and to use rations which suit his own peculiar circum-

stances; there is no such thing as the ideal or model ration which can be advocated universally. In some districts. the required concentrates may be almost entirely home grown; in other districts they may have to be purchased. Different recommendations must be made to meet the varying conditions.

Choice and Combination of Food.—Having made use of the table given in the September issue of this *Journal* to decide on the relative values of purchased and home-grown foods, the next questions of importance are, which to select to meet the particular set of conditions, and how—*i.e.*, in what proportions—to combine them to give the best results.

For these purposes, the table is reproduced except that the columns giving the unit prices for varying costs per ton are omitted and in their place is put a column headed " Balanced Rations."

In the table, foods are classified according to albuminoid ratio (which is really the portion of the total feeding value contributed by the digestible protein, as compared with that contributed by the rest of the digestible constituents): the commonly accepted starch equivalent of each is also added for purposes of reference.

The first group in the table is called Group II. On the system of classification employed, Group I would include such feeding stuffs as fish meal, meat meal and locust meal, which consist largely of animal protein. As these are of very variable nature and also are not commonly used for dairy cows, it has been thought best to omit them. It can, however. be noted that they have a still narrower albuminoid ratio than Group II, *i.e.*, a higher proportion of protein.

Now as to the uses of the table. The first point is, that for the purpose of making up production rations a food from a particular group can be replaced by any other food of the same group or by an equivalent quantity of two or more.

In making such substitutions there is no need for mathematical precision. Owing to the range of variation in composition, the degree of uncertainty concerning digestibility, the reliability to be attached to starch equivalents, and the difference in value of different proteins (which cannot yet be allowed for) it is unnecessary to go to decimal places. Thus in Group II, with the exception of undecorticated ground nut cake, all the foods may be regarded as equivalent in feeding value *when compiling rations*. Of undecorticated ground nut cake, 1¼ parts may be taken as equal to 1 part of the others. Similarly, in Group III

$1\frac{1}{2}$ to 2 parts of cotton cake may be considered equal to 1 part of any of the others.

In making substitutions, the farmer must, of course, remember the specific properties of the foods—their palatability, whether laxative or costive, and so on. But bearing such points in mind the farmer can safely use the table when selecting a feeding stuff.

Proceeding, the next important feature of the table is that Group IV is described as "Balanced Foods." The members of this group are of such an albuminoid ratio that they can be used separately or be combined together in any desired proportions, giving a well-balanced diet for the production part of a milking ration. Since maize gluten feed and peas can also be included in the group, this means that there are about 10 wholesome well-balanced foods from which the farmer can choose, knowing that the precise proportions in which he uses them are of no consequence. If all concentrated feeding stuffs have to be purchased, the farmer can hardly do better than select from this group—making use of unit prices in the selection.

Group IV is the centre of the table: foods in Groups II and III contain a higher proportion of protein: foods in Groups V and VI, a lower proportion. Accordingly if foods from Groups II and III are to be utilised, they must be balanced up with a food or foods from Groups V and VI, and vice versa. The column "Balanced Rations" shows how this can be done very simply and with sufficient accuracy.

One of the commonest mistakes in feeding cattle is to use too large an amount of a food rich in protein, *e.g.*, cotton seed meal, in the hope of forcing the animal on. Another common mistake, though less frequent than the other, is to make do with foods in Groups V and VI which are seriously deficient in protein; small farmers and others often fall into this error owing to their desire to manage with home-grown foods. If the table served only the purpose of showing where the different foods come so far as their albuminoid content is concerned, it would be well worth while.

Having emphasised the great importance of Group IV, we may pass on to discuss the precise proportions in which the foods of other groups must be combined to give suitable mixtures.

Groups III and V should be used in equal proportions as, *e.g.*, the well-known mixture of equal parts of beans and oats.

Groups III and VI should be combined in the proportions 2 to 1, giving such a mixture as 2 parts linseed cake with 1 part rice meal or maize meal.

Groups II and V and II and VI provide such mixtures as 1 part decorticated cotton cake with 3 parts oats, and 1 part decorticated ground nut cake with 2 parts maize meal, respectively.

To any of these mixtures a food or foods may be added from Group IV still leaving the mixture well balanced.

Examples of Rations.—In order to illustrate the scheme more fully and to give some indication of its limits of error, the following series of examples are given :—

Ration (*a*)	Groups III and VI	2 : 1	1 part Linseed Cake. ½ „ Rice Meal (or Maize Meal)
Ration (*b*)	„ II and VI	1 : 2	1 part Decort. Earthnut Cake. 2 parts Rice Meal.
Ration (*c*)	„ III and V	1 : 1	1 part Beans. 1 „ Crushed Oats.
Ration (*d*)	„ IV	—	½ part Coconut Cake. 1½ parts Palm Kernel Cake.

Here we have four rations, (*a*), (*b*), (*c*), and (*d*), which could be written down directly from the table. They may be used separately or better combined two or three together, or all four mixed and used as one ration.

Obviously, a great many combinations are possible—and in fact if the proportions of each ration were varied an infinite number of different but suitable rations would be the result.

Examining a few of the possibilities, and comparing them with the standard adopted by Mackintosh, namely, .55 lb. protein to 2.50 lb. starch equivalent per gallon or 1 : 4.5, the following results are obtained :—

Ration ...		*a*	*b*	*c*	*d*	*bd*	*ac*	*ad*	*abc*	*acd*	*bcd*	*abcd*
Ratio : Protein to Starch Equivalent	= 1 to	3.9	3.9	4.7	4.5	4.2	4.3	4.2	4.1	4.4	4.3	4.2

These results show how satisfactorily the system works. Even in rations (*a*) and (*b*), where only 2 foods are used, the discrepancy is not one of such an extent as to mean bad feeding. Such rations would be more justly criticised on the ground of lack of variety. Provided that in the cases of undecorticated groundnut cake and cotton cake, the adjustments already mentioned are made, any mixtures likely to be compiled by the use of the table will fall within the limits of the rations just considered.

Starch equivalent		Balanced Rations
	Group II. Very rich in Protein Alb. Ratio between 1 to ¾ and 1 to 1½	
74	Cotton Seed Meal	Group II. 1 part, Group V. 3 parts
70	Decorticated Cotton Cake	
69	Soya Bean Cake	
73	Decorticated Ground Nut Cake	Group II. 1 part, Group VI. 2 parts
57	Undecorticated Ground Nut Cake	
73	Sesame Cake	
	Group III. Rich in Protein Alb. Ratio between 1 to 2 and 1 to 3½	
40	Cotton Cake, Bombay	
42	Cotton Cake, Egyptian	Group III. 1 part, Group V. 1 part
74	Linseed Cake	
67	Beans	
71	Grain	Group III. 2 parts, Group VI. 1 part
69	Peas	
75	Maize Gluten Feed	
	Group IV. Balanced Foods Alb. Ratio between 1 to 3½ and 1 to 5½	
41	Malt Culms	
18	Brewers' Grains	
75	Palm Kernel Cake, 6 per cent. oil	
71	Palm Kernel Cake extracted	
79	Coconut Cake	All balanced and can be used in any desired proportions
	Wheat Offals—	
72	Fine Middlings	
64	Coarse Middlings	
60	Pollards	
45	Bran	
120	Linseed (whole)	
	Group V. Starchy Foods Alb. Ratio between 1 to 7 and 1 to 8.	
60	Oats	Group V. 1 part
71	Wheat	Group III. 1 part
71	Ryc	Group V. 3 parts
85	Maize Germ Meal	Group II. 1 part
	Group VI. Very Starchy Foods Alb. Ratio between 1 to 10 and 1 to 12	
81	Maize	Group VI. 2 parts
72	Rice Meal	Group II. 1 part
71	Barley	Group VI. 1 part
		Group II. 2 parts

How the System may Prove Useful.—1. *In the Class Room.*—Every young man attending a course of instruction in agriculture at one of the Farm Institutes must be taught the principles of animal nutrition, and generally he receives instruction in the compiling of suitably balanced rations. Owing, however, to the shortage of time and also to the very common aversion to arithmetical calculations found amongst students, it often happens that the student leaves the Institute without having acquired such a facility for making up rations that he will actually proceed to compile his own on the farm. For such students the scheme outlined will serve as a useful illustration and summary of such ideas as albuminoid ratio and starch equivalent. The table is so simple that he will regard it as a friendly aid always at hand. Incidentally, it will serve to keep fresh some of the principles emphasised in his agricultural course.

2. *To the Practical Farmer.*—To the farmer who has not had the opportunity to attend an agricultural course the scheme will be still more useful. It will assist him to draw up his plan of winter feeding, to give instruction to his cowman, and to meet many difficulties which may arise.

3. *Finally, to the Agricultural Organiser* with a dozen different inquiries to answer ranging over a wide field, it will mean a considerable saving of time in answering such of the inquiries as relate to the feeding of dairy cows. Queries over the telephone can be answered immediately, and questions asked at lectures or in the market place can be given both a correct and ready answer. The psychological effect of such a prompt reply can hardly be over-emphasised.

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DAIRY FARMING ON MASS PRODUCTION LINES.

THE Ministry has received from one of its Inspectors, Captain V. L. Yates, the following account of an unusual method of dairy farming which is being successfully practised upon an upland farm in Wiltshire, and by the courteous permission of the farmer by whom the system is practised, is able to publish the following description.

The farm consists of 1,800 acres on the Wiltshire Downs at an altitude of 700 feet above sea level. It was formerly an arable and sheep farm, but has now all been laid down to grass. About 1,000 acres was light barley land, but the lower land was very heavy and sticky, capable of yielding heavy crops of wheat and beans.

Stock.—The system of obtaining stock is to go to Ireland once or twice a year and pick up a supply of little heifers which have stolen the bull—undersized animals which most other dealers will not look at. These animals are brought over and run on the hill farm in the open winter and summer. They are never housed, in rough weather receiving hay and a ration of concentrated food fed in the open. As they calve down they are brought into the dairy. They are given a rest before being sent to the bull a second time, being served again about three months after calving. As they calve down the second time they are sent to market, and sold with calf at foot. These animals cost about £18 placed on the farm, and sell out after having given a year's milk and calf at an average price of £21-22.

Naturally enough a number of the animals are no good as milkers. These are not served a second time but are dried off, sold as stores or grazed. The improvement which takes place in these cattle is extraordinary—little bits of heifers develop out of all imagination, the free range and ample food doing wonders. At the present time there are 600 head of stock on the farm, but it has successfully carried 800.

Milking.—The principal feature of the system is the use of movable milking sheds. These sheds, in which 12 cows can be milked at once, are fitted up with a milking machine, power being obtained from an oil engine fitted in a shepherd's hut. Round the shed a pen is constructed on exactly the same lines as those used when folding sheep. The shed and corral are

moved daily. At milking time the cattle are rounded up into the pen and in batches enter the movable milking shed, to which has been fitted a small manger on one side of every stall. Above each stall and manger is a hopper, holding concentrated food sufficient for the day. As the cows enter, a lever is pulled and a ration of 3 to 4 lb. of concentrated food drops into the manger. A chain is then drawn across the rear of the cow to prevent her backing out and the milking machine starts work. As soon as the cow has been milked and hand stripped, a second lever is pulled which opens a door in front of the cow, which goes out and another one takes her place, and the work continues.

About 400 cows are milked in this way, three sheds being used.

The average milk yield per cow was 630 gal. in 1923-24, and 680 gal. in 1924-25, whilst the total labour costs per gallon were $1\frac{8}{9}$d. and $1\frac{5}{8}$d. respectively. This system has been working for four years and costs of production have been reduced each year by introducing improved methods. The labour costs now stand at $1\frac{1}{2}$d. per gallon.

Improvement of Pastures.—An interesting point in connection with the system is the improvement effected in the pastures. A large field that had tumbled down to grass was a mass of couch. The cows were brought into a fold for milking on the field, the shed being moved every second day, and at the end the field was trodden flat. After a few weeks to allow for rain to wash in the manure it was harrowed, and white clover and perennial ryegrass were sown. To-day it is as good a field as one would expect to see, full of white clover. In this way all the pastures including Downland are being gradually improved in turn.

The great advantage of this system is that there is no manure carting. The fields receive a level dressing, and the liquid manure is not lost. Extensive experiments have also been carried out on grasslands with artificials.

Buildings and Water Supply.—Another point in the system is watering. There are no natural springs or ponds on the farm. Two wells have been sunk and the water is pumped to a reservoir on the farm and water is laid on in each field, each drinking trough being controlled by a stop tap. It is estimated that 10,000 gallons are pumped per day.

With regard to farm buildings, an old church has been converted into a dairy. Here are a number of appliances, includ-

ing a large ice plant and cold store, the latter being used in the summer to keep back milk for week-end trade. A brine cooler, etc., is installed. At the farm is the office, where two girl clerks are always kept busy.

This system has been referred to as dairy farming on ranching lines, but the methods and policy adopted are not dependent on area—230 acres of grassland carried 160 cows throughout the summer. There would appear to be no reason why a farmer with 100 acres and 30 cows should not adopt this system. It is suggested that the best results would be obtained from a herd of 50-60 cows milked and handled by a man and a boy.

Where climatic conditions are unsuitable and the land is too wet for winter grazing, the portable plant could be taken to the buildings during the winter months—and the advantages of penning, healthy open-air conditions, and cheap manuring be utilized in the summer.

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THE POULTRY INDUSTRY.

POULTRY keeping in this country has in recent years developed to a surprising extent. According to a census taken by the Ministry the number of poultry kept on holdings of one acre or over has increased from 24,816,000 to 30,755,000 during the past three years. This figure takes no account of the very considerable development in poultry keeping among cottagers and urban dwellers. Further, farmers who formerly took little interest in poultry as a means of livelihood are rapidly altering their outlook, as it has been conclusively shown that when properly managed poultry may be a very paying proposition, especially in conjunction with a farm. Fortunately, also, the industry is by way of being well organised. This is chiefly due to the efforts of the National Poultry Council, which includes representatives of all classes of poultry keepers. There is still abundant scope for development in the industry, as is shown by the fact that approximately £28,000,000 worth of eggs and poultry are still being imported annually into this country from overseas, including Ireland.

The Ministry's policy has been to encourage the organisation of the industry as far as it is practicable for a Government Department to do so, and at the same time to stimulate local

authorities and other educational bodies to provide instruction and advice, and above all to raise the standard of poultry kept in the country. An Egg and Chick Distribution Scheme, devised by the Ministry during the War, has been adopted by the majority of local authorities, and by means of that scheme cottagers, smallholders, and others are able to obtain in most counties sittings of eggs or batches of chicks at very reasonable prices, from approved poultry breeders. The distribution of eggs and chicks under this scheme is carefully watched by the county poultry instructors and is followed up by advisory work.

Another scheme which is regarded by the Ministry as of considerable importance is that of egg laying trials. When these are organised by a local authority they are usually aided by substantial grants from the Ministry. Here also the advisory work of the poultry instructor is of great importance. It may be mentioned that 54 poultry instructors are at present at work in 38 counties. The educational facilities range from single lectures or series of lectures to short courses at farm institutes and agricultural colleges, and further to a long course extending over two years and providing a very complete training leading to the award of the National Diploma in Poultry Husbandry. This diploma is a post-war innovation. The award is made by the National Poultry Council on the recommendation of a special examination board.

A developing industry soon feels the need for further scientific knowledge, and poultry keepers have shown a practical desire for this by contributing over £6,000 towards the capital expenditure on a scheme of scientific poultry research. This scheme, known as the National Poultry Institute Scheme, was suggested both before and during the War, and the original intention was to concentrate all the work in one building to be called the National Poultry Institute. On further consideration it was felt that this was financially impracticable, and, as a final result, the research and education work required under the scheme will be distributed among various centres.

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A GROWER'S POWER SPRAYING OUTFIT.

A. H. HOARE,
Ministry of Agriculture and Fisheries.

NOT infrequently farmers, fruit growers and others find it expedient to design some special implement to meet peculiar conditions. Often, too, existing machines of a standardised pattern are modified in some particular feature to render them more serviceable. It is in this respect that a general knowledge of mechanics and engineering principles often stands the farmer in good stead.

Most fruit growers are familiar with the usual type of power spraying plant which, in order to obtain mobility, is mounted upon four wheels and drawn about by a horse. The essential components of these outfits are an oil or petrol engine, a pump provided with a pressure regulator, and a large tank to hold the spray fluid. Such spraying plants are either connected up to the piping system of the plantation, in which case they remain on the headlands or, where no pipes are laid, are drawn up and down between the rows of trees with the equipment of delivery hoses and spraying lances directly coupled up with them.

Few of the outfits of this kind on the market possess features which are incapable of improvement, if not for general work then for special contingencies or peculiar working conditions. A not uncommon criticism is that whereas the engine fitted is of sufficient strength to operate the pumping and other mechanism for spraying, it is useless for any outside purpose for which, upon the average farm, power is required. Engine power comes in handy for operating chaff-cutters, saw-benches, winnowing machines, dynamos and the like.

The accompanying illustration shows a portable power spraying plant designed throughout by a Kentish fruit grower (Mr. W. G. Furner, Venner's Farm, Erith), and serves to illustrate how a grower may, with a little thought and ingenuity, acquire a really useful and efficient piece of farm machinery, capable not only of dealing with the spraying of a large acreage of fruit, but of rendering constant service in the routine operations of a mixed farm.

The method of procedure adopted by this grower was to purchase the components separately; they were then assembled according to his instructions by local engineers. The writer has had an opportunity of witnessing the plant at work and was much impressed with its high efficiency.

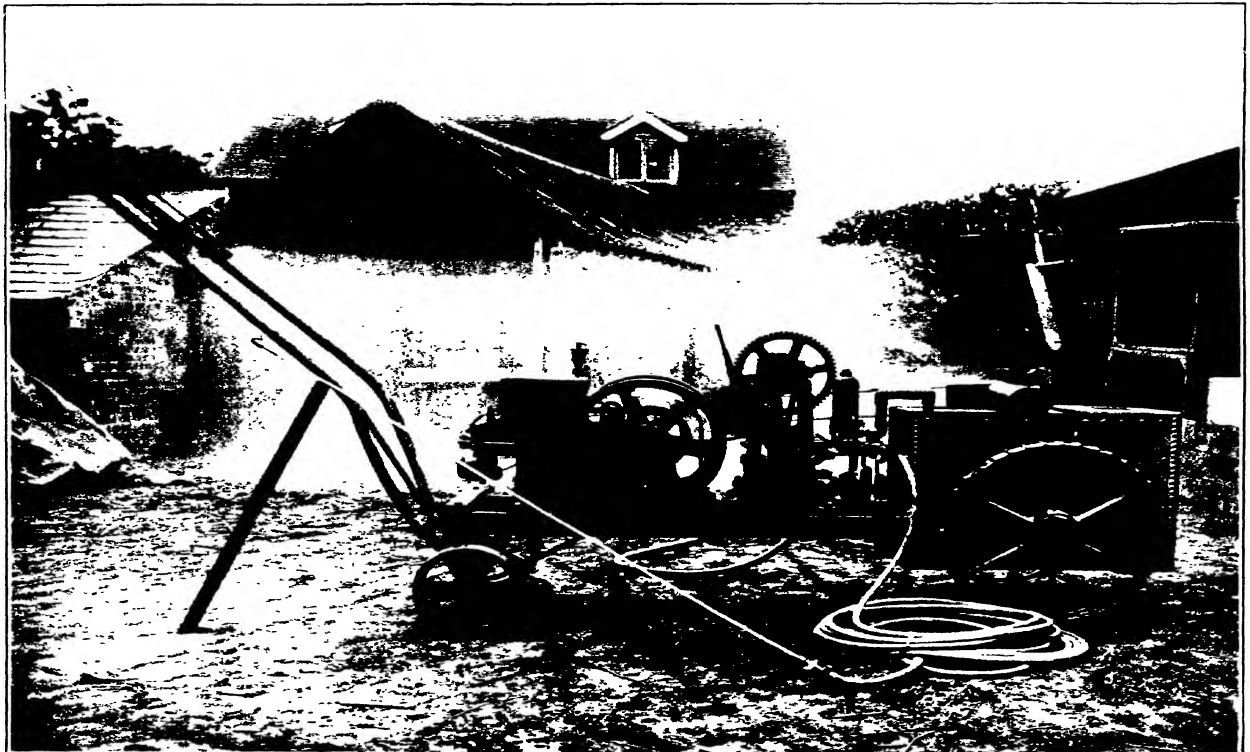

FIG. 1.—Power Spraying Machine.

Briefly, the specification is as follows (a comparison is made with the general rule amongst outfits of similar design):—

Frame.—This is of 4-in. steel channel with 3-in. cross pieces. A common fault with spraying outfits is that the frames tend to whip when running at full power. This is due to the use of smaller size framing. The greater rigidity obtained by using 4-in. framing ensures against breakage, and saves wear and tear of the engine. Effective clearance of the front wheels is given to provide a good lock for turning.

Engine.—The engine employed is a 4-h.p. Ruston & Hornsby, running on paraffin but starting on petrol. This is the chief improvement in the outfit, the advantage lying in the fact that this engine is capable of operating the farm's saw-bench, chaff-cutter, etc., for which, with the usual 2¾-h.p. engine, the plant would have been incapable.

Pump.—This unit is of the three-throw ball plunger type, connected with a pressure regulator to guard against the bursting of hoses when the men turn off the flow. Two delivery cocks, one on either side, are fitted. This arrangement facilitates the working of short and difficult angles and awkward corners of a plantation where no mains are laid. Further, it obviates a complete stoppage of the equipment when one delivery is shut off owing to a blockage. All that is necessary in such case is to shut off one cock. Gearing is supplied for switching the pump in and out of gear with the engine from which it is chain driven. The pump is a strongly constructed piece of mechanism built by Messrs. Drake & Fletcher, of Maidstone.

Tank.—A 95-gallon tank is employed, which is very much larger than that of any known outfit. It is fitted with a square copper-wire gauze strainer and a rotary agitator driven by belt instead of chain, direct from the engine. The rotary agitator ensures an efficient disturbance of the liquids and the absence of a chain reduces the noise.

Wheels.—The rear wheels are light but strong—they are, in fact, old wheels from mowing machines and serve execeedingly well for the purpose.

Notwithstanding the many improvements in this spraying plant and its enhanced general value the cost of whole assemblage was very much less than that of a similar outfit purchased complete and with a weaker engine. It is, therefore, manifest that growers may be able not only adequately to improve their farm equipment but to save money in the process.

When Mr. Furner's outfit is not at work spraying his fruit trees it occupies a building wherein there are a saw-bench, chaff-cutter, and other machines which are operated with great success by the 4-h.p. engine. Thus this home-designed plant is profitably employed throughout the year, but most effectively when in the plantations operating seven or eight spraying nozzles at considerable pressure for long distances.

GARDENING CLASSES IN AN INDUSTRIAL CENTRE.

The Birmingham Corporation Scheme.—Although Birmingham, which has always prided itself on its educational policy, has not, for financial reasons, been able to do as much in horticultural training as the Authorities would like, yet the classes which are held under their supervision may well be taken as an example by other cities. The Birmingham scheme of horticultural education includes lectures during the winter, with practical instruction carried on throughout the year on plots situated on some of large allotment grounds in various parts of the city. Some details of one of these practical classes, Burney Lane, Alum Rock, on the east side of the city, first formed in 1913, may be of interest as a typical example of the practical work done.

The area of ground used is approximately 112 ft. x 60 ft, divided into smaller plots giving accommodation for 15 students. The land is a sandy loam with gravel subsoil and has a gentle slope facing south. An excellent stores shed is provided in which each student is allotted a space for his kit of tools. etc., for which he is responsible, prizes being awarded each season for the best and most neatly arranged set.

The class meets two evenings weekly during the spring and summer months, and on Saturday afternoons during the winter. The year's work commences the first week in December, the plots being selected by ballot. It is a curious fact that the class has always had a majority of girl students, although possibly its formation during the war may have a good deal to do with this.

The first operation, in which students are initiated early, is bastard trenching, this being undertaken over half of each plot, farmyard manure being incorporated in the process. A three years' course of cropping, on the lines laid down in the Ministry's Leaflet No. 315, is practised, and all students are required to provide themselves with notebooks in which they draw a plan of their plot, and mark thereon as a guide the distances for planting in rows and for the between plants. Full particulars as to the times of sowing, gathering and weight of crop, together with the time taken for the various operations, are other items of information to be noted.

The usual vegetables naturally cover most of the ground, but flowers are not neglected, being grown at the front of the plot.

FIG. 1.—Messrs. Cadbury's Gardening Classes for Girls.

FIG. 2.—Messrs. Cadbury's Gardening Classes for Boys.

This flower culture appeals particularly to the women students who are, however, equally keen on the growing of foodstuffs. Each student is entitled to the product of his plot, the total value of the produce, apart from flowers, raised by the students during 1918 amounting to £36 7s. 4d., while the average yearly value of the total crop since the start in 1913 is approximately £20.

It is found that these classes have an indirect effect on other growers, which is as beneficial as the results to the students. The class area serves as an education centre for all the surrounding allotment-holders, who follow with interest the course of cropping and methods of cultivation, and in many instances copy them, with satisfactory results.

The lectures classes in gardening during the winter session are mainly on ordinary lines, but one of the lecturers also continues his class during the summer months, meetings being sometimes arranged in the public parks, and also in well-conducted private gardens, whose owners are pleased to give facilities for these visits and often extend hospitality to the students. Apart from these classes and lectures the Local Authority has engaged the part-time services of a well-known and experienced horticulturist, who visits allotment centres on Saturdays at stated hours and gives help and advice to the holders present.

Messrs. Cadbury's Scheme.—Another scheme of horticultural education in Birmingham is provided by Messrs. Cadbury, of Bournville, whose works now lie within the city boundaries. Many large commercial firms take keen interest in the welfare of their employees but few go so far as to provide, like Messrs. Cadbury, land and instructors for education in gardening. Under the firm's Director of Education, classes are held for both girls and boys; the girl students number about 20, and there are 16 students in each of the boys' classes. The boys are, on the average, younger than the girls, and they are eligible to enter the class at the age of 14 to 15, moving out of the class automatically on the completion of their three years' course, upon which they are encouraged and given every facility to acquire an allotment so that their interest in gardening is maintained to manhood.

For the girls there are vegetable and fruit plots which are used for demonstration purposes, and all students share in their cultivation even to the digging and trenching. The vegetable plot is about 400 square yards in extent and the fruit plot some 300 square yards. Apart from these, each student has a separate

plot of about 30 square yards, devoted to the cultivation of flowers, and a set of tools for which she is responsible. The fruit plot contains characteristic varieties of apples, pears, plums, blackcurrants, raspberries, gooseberries, and loganberries, and the produce of both the fruit and vegetable plots is divided among the students.

The course for the girls is arranged to cover three years and there is generally a waiting list of prospective students. The class meets on three nights a week in the summer but only on Saturday afternoons during the winter. Tuition is not confined to work on the plots but visits are arranged to enable students to get an insight into glasshouse work, and once during the course a visit is organised to Kew Gardens. Prizes are given for the best flower plots and the students also compete in the Bournville Show.

In connection with the boys' classes there is a demonstration plot, also common ground where such things as marrows are grown, the produce being shared; but apart from these each boy has a plot of 75 square yards, on which to cultivate vegetables, and a fruit plot of about 45 square yards. The latter is usually equipped with two apple trees, one plum tree, two redcurrant bushes, two blackcurrant bushes and two gooseberry bushes, while room is also found for raspberries, rhubarb and some herbs. A fee of 1s. per annum is charged and, as in the girls' class, tools are loaned to each boy and prizes awarded on similar lines. The entire produce becomes the property of the student. Small grants are given towards the scheme by either the Board of Education or the Ministry of Agriculture, but the greater part of the expense is defrayed by the firm.

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NOTES UPON BULB MITES AND EELWORMS.

A. S. BUCKHURST,

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BEFORE any considerable piece of research is undertaken it is often necessary to carry out minor preliminary experiments to decide upon what lines the more important investigation should be planned. Such preliminary trials are not expected to give conclusive results, but points sometimes emerge from them which are worthy of record if only to assist other investigators in designing trials upon a larger scale. The following notes arise out of experiments of this nature.

Experiments with Bulb Mite.—Complaints are sometimes received that bulbs exported to overseas countries are found on arrival at their destination to have been destroyed by Bulb Mite (*Rhizoglyphus echinopus*), involving, at times, very considerable financial loss. On the other hand, many of those engaged in investigating bulb pests during recent years have become doubtful whether bulb mites can destroy a bulb which is otherwise in a healthy condition, and it has seemed to them possible that the loss of the bulbs sent overseas was not primarily due to bulb mites but to some other factors at present undetected. As one of the means of investigating this question small experiments were undertaken in the autumn of 1924 at the Ministry's Plant Pathological Laboratory, Harpenden, to try and discover how far the bulb mite is responsible for direct damage to narcissus and hyacinth bulbs.

Mites obtained from diseased bulbs were kept in damp, warm conditions in covered glass jars, where they multiplied with great rapidity. On 30th September, 1924, twelve each of the following narcissus varieties were planted:—Sir Watkin, Golden Spur, White Lady, Soliel d'Or, Barrii Conspicuus, and Poeticus ornatus. These were potted in sterilised soil, and approximately 100 mites were introduced into the neck of six of each variety, the remainder being uninfected. The pots were then plunged into an ash bed and covered with sterilised peat moss litter. On 2nd October twelve mixed hyacinths were planted in a similar manner, eight of these being infected with mites, which, in this case, were introduced between the scales. The bulbs were allowed to flower in the ash bed, and with one exception all produced good, normal blooms, no difference being noticeable between the infected plants and the controls. The exception was one Poeticus, in which the foliage was poor and the blossoms (two flowers) distorted and stunted. This bulb was lifted and examined in June. It was originally an undersized bulb, and it now showed an area of diseased tissue running from the neck almost to the base of the bulb. Large numbers of mites were found in the diseased tissue and on the outside of the bulb, but no other pest or fungus disease was discovered. For the present it must be assumed that this bulb was in fact damaged by bulb mite. The remaining bulbs were lifted in the beginning of September, 1925, and all, both narcissi and hyacinths, were found to be perfectly sound and healthy. It is also important to record that mites were present on every bulb, not only upon the deliberately infected bulbs but also upon the controls.

The above experiment, so far as narcissi are concerned, seems to support the views of those who hold that the bulb mite is not a primary pest. Seventy-two bulbs were used and half of these received a heavy infection of bulb mites, with the result that only one bulb appeared to suffer. Even the solitary case of damage noted was not convincing, as the bulb was of poor quality to begin with, and some slight injury that afforded the mites ingress was possibly overlooked.

As regards the experiments with hyacinths, the numbers employed were too few to justify very definite conclusions, but so far as they go they again suggest that the bulb mite can do little direct harm, and this view is further supported by an involuntary experiment which happened as follows: The culture from which the bulb mites were obtained was preserved until August, 1925, the vessel containing it becoming literally "alive" with bulb mites. In order to provide food for the mites a healthy hyacinth bulb was placed in the culture during the autumn of 1924, and although the dead outer scales of the bulb were to some extent eaten by the mites, the bulb remained quite sound and finally produced a normal flower. The bulb thus grew and flowered normally in a culture of its supposed enemy! Further experiments with narcissus Poeticus and hyacinths have been planned in order to confirm the results of the above experiment, while other experiments are in progress in order to settle the question of the loss of bulbs sent overseas, but so far as the work has progressed it would seem unlikely that the bulb mite will be found directly responsible for the trouble.

Eelworms in Potatoes.—It will be remembered that in the autumn of 1924 there was considerable discussion as to the occurrence of eelworms upon potatoes, the species which excited most attention being apparently a form or race of the Beet Eelworm (*Heterodera schachtii*) (also known as the Hop Eelworm). This eelworm attacks the small roots and rootlets but not the tubers, and was associated with—though it was not clearly proved to be the cause of—considerable damage to early varieties of potatoes in several parts of the country. It was also found to be widely distributed upon main crop varieties which as a rule seemed to be healthy and unaffected by the attack.

Another species of eelworm—a form or race of the common Stem Eelworm (*Tylenchus dipsaci*), so well known in connection with injury to clover, oats, bulbs, etc.—has, however, also been shown recently to attack potatoes. The tubers in this case are affected, with the result that rotting in the pits is caused.

In the case of both these eelworms it is clear that a race has developed which is specially attached to the potato, and from the practical point of view it becomes important to know what other crops besides potatoes these special races of eelworms can attack, since the chief method of controlling eelworms under field conditions is to starve them out. For this reason small preliminary experiments were started at Harpenden to determine whether the potato races of the beet and stem eelworms were able to attack other crops. The full investigation into this question has now been taken over by Dr. Leiper of the London School of Hygiene and Tropical Medicine, and experiments are in progress at the Agricultural Institute, Kirton. Full information will therefore become available, but in the meantime the following notes may be of interest:—

1. *Stem Eelworms (Potato Race)*.—A number of "King Edward" potatoes infected with the stem eelworm were received from Lincolnshire in 1924. Three of these were planted in sterilised soil, in pots, to determine whether infected seed potatoes would cause an infected crop the following year. Two others were cut up into small pieces and mixed with sterilised soil, which was divided into seven pots. In six of these "Sharp's Express" potatoes were planted, in the other, oats were sown. Six further "Sharp's Express" and a further pot of oats were grown in normal sterilised soil as control. The potato plants showed no unusual symptoms as regards the foliage, although two of the "King Edward" plants, two infected "Sharp's Express" and one control, developed the bacterial disease "Blackleg." The oats showed no signs of developing "Tulip Root," and microscopic examination revealed no stem eelworms. In early September the potatoes were lifted. The "King Edwards" yielded in all 24 tubers, of which two were attacked by eelworm, three were destroyed by the Blackleg organism, and 19 were sound. The "Sharp's Express (infected) gave 51 tubers, of which 29 were attacked by eelworm, four by Blackleg, and 18 were sound. The "Sharp's Express" controls yielded 58 tubers, of which four were affected with Blackleg, the remainder being sound. The attacked tubers showed the characteristic cracking of the skin which the original "King Edwards" exhibited; internally the substance of the potato was rotted for a greater or lesser distance from the skin, the rotted parts swarming with eelworms in all stages. There was no evidence that the attack had commenced at the point of attachment of the tuber to the rhizome; the initial point of attack varied in individual tubers.

The experiment is too small to justify definite conclusions, but it strongly suggests that the stem eelworm is a primary pest of the potato and not, as had seemed possible. a secondary parasite which entered the tuber only if this had been injured or attacked by some other organism. It also suggests, though the evidence from twelve plants is rather slender, that the *Potato race* of the stem eelworm cannot subsist on oats, a crop which is so susceptible to stem eelworm, but evidently of a different race.

2. *Beet Eelworm* (*Potato Race*).—A potato plant infested with this eelworm was received from Lincolnshire in 1924, and was kept throughout the winter in a pot of damp sand (previously sterilised). In the spring the sand was divided into seven parts and each was mixed with a pot of sterilised soil. The following seeds were planted in six of the pots:—oats, wheat, beet, white mustard, peas, and broad beans, and in the seventh one of the tubers from the original plant was allowed to grow. In early September the plants, consisting of six each of beet, beans and peas, and twelve each of oats, wheat and mustard, were examined. No trace of the beet eelworm was discovered either upon the root fibres or in the roots of any of the plants except of those of the potato, which showed a typical attack, mature females being found on all the smaller rootlets

Here again the experiment was on much too small a scale to justify definite conclusions, but it certainly suggests that the potato race of the beet eelworm does not attack any of the six kinds of crop tested, although other races of the same worm are not infrequent upon oats, beet and peas—in fact, on the Continent the beet race of this eelworm was a definite menace to the growing of sugar beet. If, therefore, the results of these preliminary experiments prove to be well founded, it would appear that there are several crops which could safely be planted on eelworm-infested land so as to avoid planting potatoes, and thus " starve out " the eelworms.

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THE BUZZARD.

F. Howard Lancum, F.L.S., F.Z.S., F.E.S.,
Ministry of Agriculture and Fisheries.

It is satisfactory to note that this noble-looking and comparatively harmless bird of prey is increasing again in Great Britain. At one time a common object of our countryside, years of persecution told their tale in its sadly reduced numbers, and for a time

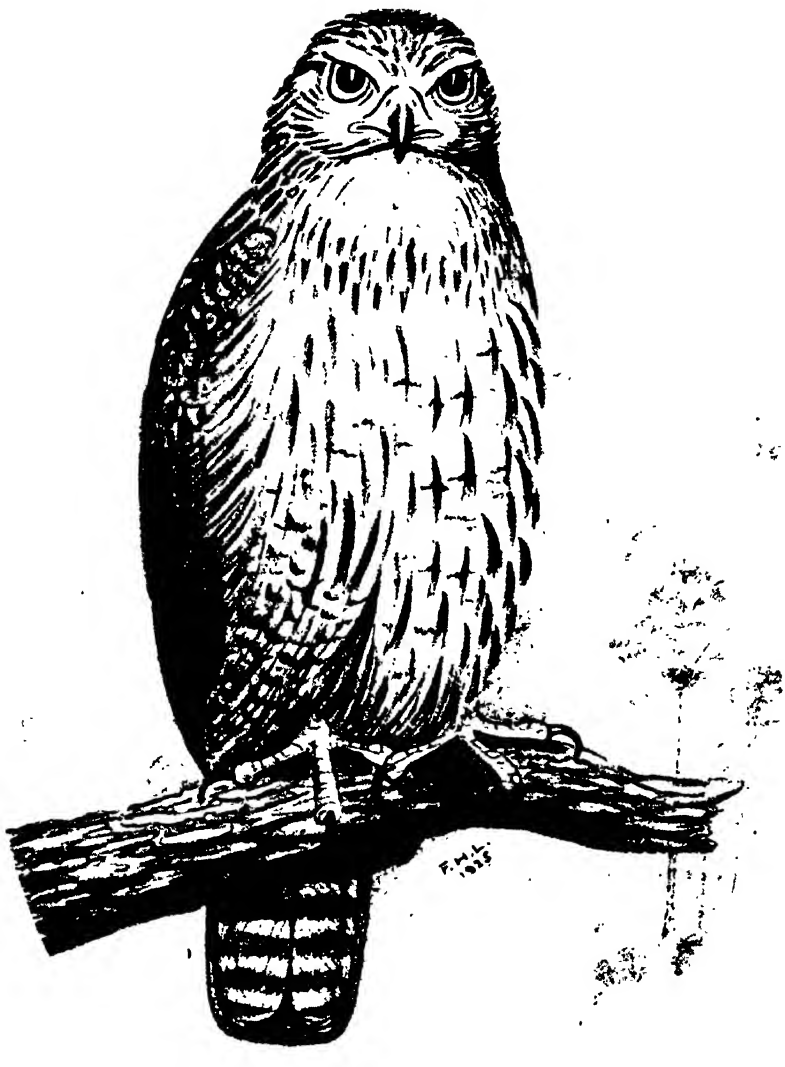

FIG. 1.—The Buzzard.

it only maintained a precarious footing in the wilder and more remote districts. In the north, west, and south-west it may now be regarded as a well-established breeding species, and in the south-western counties most large woods harbour at least one pair of buzzards. In May of this year, the writer found no fewer than three nests, all in use, within an area of four square miles of woodland. They contained, respectively, one egg, three eggs, and three young birds.

This pleasing growth in numbers may be largely attributed to a change of attitude on the part of landowners and gamekeepers. The latter, not unnaturally, are prejudiced against birds of prey as a whole, and in some cases it must be admitted that there are substantial reasons for their antagonism. In the case of the buzzard, however, many keepers have satisfied themselves by careful observation that the bird is practically harmless from a game-rearing point of view. Indeed, in many districts buzzards are protected by keepers and others interested in game preservation, and of the birds' value to agriculture there can be no doubt. The food of the buzzard comprises rats, mice and other small animals, an occasional small bird, beetles and other insects, earthworms and frogs. It is also addicted to the consumption of carrion, and a dead and slightly " high " rabbit appears to be particularly attractive to it.

The crop of a specimen examined by Cecil Smith was full of earwigs, and another in a bird found dead by the writer in 1923 contained, amongst other material, numerous cockchafers and two stag beetles. To the Rev. F. C. R. Jourdain the writer is indebted for a reference to F. M. Ogilvie's " Field Observations," wherein it is stated that an adult buzzard, in addition to larvæ of the privet hawk moth, contained a mass of beetle remains.

Yarrell, in his " British Birds," quotes the opinion of another ornithologist that the buzzard is " of great service to farmers in driving off the ring-doves feeding on the corn," with which opinion he concurs, as, although the buzzard would be unable to capture a healthy ring-dove on the wing, the presence of a large hawk near the corn fields would doubtless have the desired effect.

The buzzard has a rather stolid, flapping habit of flight, but at times—notably during the breeding season—it may be seen circling majestically around at a considerable height. In such circumstances it is unmistakable, its broad, rounded wings and its fan-like tail distinguishing it from our other birds of prey.

Its peculiar call, somewhat resembling the "mewing" of a cat, also affords a ready means of identification. The adult buzzard (see Fig.) sometimes attains a length of twenty-two or even twenty-four inches. The head, back, wings and tail are dark brown, the tail being barred with lighter brown. The underparts are buff, streaked and barred with brown. The feet and cere are yellow, and the irides are hazel.

The nesting habits of the buzzard are much like those of other hawks. The nest is sometimes situated among rocks or on cliffs, and has even been found on the ground, but in wooded districts it is most frequently built in the higher branches of a tall tree. The writer has a keen recollection of his last climb, undertaken for the purpose of ringing the young birds, to a nest in a sixty-foot pine, a task that proved literally to be full of snags.

Many buzzards build a fresh nest each spring, but in some cases the same nest is used year after year, and as the pile of sticks is continually being added to, it sometimes attains enormous proportions. One could quite comfortably sit on the nest referred to above, which was placed in a substantial fork of the tree. A striking peculiarity of the buzzard's nest is that it is nearly always lined with fresh green leaves or branches, and as yet no theory has been advanced in explanation of this habit. Many writers state that beech leaves are most often used for the purpose, but most of the nests which the writer has inspected were lined with green larch twigs or pine needles. The lining is renewed by the birds from time to time, so that a nest may contain fresh leaves at any period of its occupation.

The eggs are usually three, but occasionally four in number. Their ground colour is a dull white, and they are rather sparingly marked with reddish brown. Unmarked eggs are, however, quite common. In their early stages the young are clad in greyish down, and the full fledging period is about 40 days. During this time they consume large numbers of mice, beetles, and other small fry, and an examination of a nest will convince an observer that the supply is usually more than equal to the demand.

Altogether, accumulated evidence goes to show that the buzzard is a beneficial bird, of undoubted value to agriculturists and well worthy of their protection.

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NOVEMBER ON THE FARM.

J. R. Bond, M.Sc., M.B.E., N.D.A. (Hons.),
Agricultural Organiser for Derbyshire.

Field Operations.—Weather and soil conditions during the present autumn have on the whole favoured the operations of stubble cleaning, wheat sowing and the lifting of potatoes and mangolds, and generally farm work is well forward. Potatoes, however, have in many cases been lifted in rather tender-skinned condition, the risk attending which was mentioned in last month's notes.

In the ordinary course, wheat after the above-mentioned root crops will be sown in good time this year. Should conditions delay or prevent the use of the drill, the seed may be broadcast and cultivated in; or if the land has not been ploughed, it may best be covered with a broad shallow furrow. Autumn sown seed should not be buried deeply.

Turnip crops where drawn off the land are lifted and stored in November; and for sound keeping it is essential that the roots be not suffocated by making the heaps large or covering them with too much soil. The results this year have varied between wide limits. Crops sown late on strong land may have failed completely; but on lightish land in the moist upland districts, where early sowing is practised without fear of mildew, crops of swedes this year are exceptionally good. In the middle of October I determined the yields per acre of the crops entered in the Matlock Ploughing Society's Competition, and found the actual weight of topped bulbs on the selected parts of the best three crops to be at the following rates per acre:—1st prize, 43 tons; 2nd, 39 tons; 3rd, 38¾ tons. These are the heaviest crops I have met with in the course of several years' judging for that Society, and they were all grown at an elevation of about 800 feet. In the lower parts of Derbyshire mangolds, cabbage, and now marrow-stem kale take the place of swedes; and in this connection it may be of interest to record that cabbages weighing 73 lb. each were exhibited at the Brailsford Ploughing Match at the end of September.

Stubble Ploughing.—Manuring and ploughing of stubbles for roots and potatoes in 1926 will normally follow the completion of wheat sowing. Opinions differ regarding the wisdom of autumn manuring for roots. The arguments advanced against the practice are that it involves loss of manurial constituents by leaching, that the manure favours the

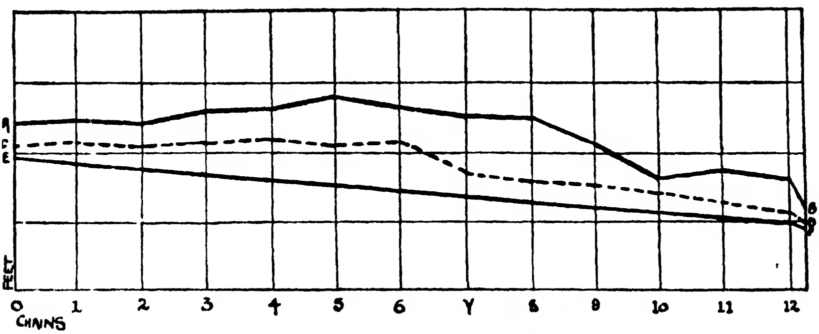
winter growth of we[illegible] soil wet. If manure is available, it will generally be better preserved in the soil than in an open yard. The soil retains phosphates and potash with little loss, and nitrogen is retained until nitrification has taken place. The nitrifying organisms cease activity at 45° F. to 40° F.—temperatures not ordinarily exceeded by the soil in November; hence there is little need to fear loss by the washing out of nitrates following November manuring. As regards the growth of weeds, temperature is again the controlling factor: weeds buried after the soil has cooled down in November or December can make little fresh growth, whether with or without manure, until the return of warmer conditions in spring.

On heavy land, the ploughing in of yard manure well in advance of the spring tilth-producing operations is advantageous in two ways. It not only saves time and moisture in spring, but it also favours the production of the crumb structure or arrangement of soil particles that is characteristic of good tilth. The fermentation of organic matter in the soil has been likened by German workers to the action of yeast in leavening bread; but its leavening effect is more generally ascribed to the carbon dioxide generated by fermentation, which clots or granulates the gelatinous matter (colloids) with which soil particles are surrounded. If the manure is not applied until after the tilth has been obtained, then obviously some of the benefit of the organic matter in it has not been utilised.

In this connection the depth of ploughing has an important bearing. To smother surface-running weeds such as twitch, deep work has been advocated in these notes: lack of air (and light) prevents their growth when deeply buried. The same practice in covering manure would prevent the decay and fermentation which it is desired should take place on the return of warmer conditions early in spring.

Draining.—Everyone who has read Wren Hoskyns's classic "The Chronicles of a Clay Farm," will remember the practical difficulties which were encountered when it was proposed to drain the twenty acres. Local opinion was outraged by the idea of attempting to drain a field that collective wisdom had pronounced undrainable "because there was no fall." Actual trial with the spirit level, however, revealed the existence of a fall of 9 ft.; tiles were obtained; and the head drainer was instructed to open drains 3 ft. deep at the outlet and 18 in.

deep at the tail, but not ...
been verified with the instrument. The head drainer, having been engaged in draining for forty years, considered he ought to know what was required in clay land; 3 ft. was no use; it would never drain so deep. He was soon discovered hard at work cutting a drain 18 in. deep, laying in the tiles one by one, and filling in the earth over them as he went on.



AB ~ SURFACE LEVELS.

EF ~ BOTTOM OF DRAIN.

Whatever views may be held as to the correct depth in different circumstances, there can be no question about the need for proper attention to the levelling of the bottom of the drain before the tiles are laid. A practical drainer when working with the help of water can make a short drain that will give satisfactory service, provided that the case is simple and straightforward; but the following example, which is one of a number in the writer's experience, may emphasise the fact that even the practised eye alone is not a sufficient guide. In the illustration herewith the dotted line CD represents the bottom of a long main drain as cut and prepared by an experienced drainer, who was anxious to lay the pipes at once, lest the sides should fall in if rain fell. The farmer, however, knowing that the utility of the whole scheme depended on the efficiency of the main drain, decided to have the levels read. Readings were taken at intervals of one chain throughout the length of the cutting. The plotted section shown in line AB represents the surface of the field, and EF the line which the bottom of the drain must follow. As the illustration shows,

there was, in the cutting as prepared, actually a back-fall from near the middle, which would have rendered the drain useless or perhaps worse than useless. The wet land to be drained lay at the left hand of the figure, where minor drains were intended to be cut. After the levels had been read and recorded, written instructions were given to the drainer regarding the actual depth required at each of the 13 marked intervals.

While for large schemes, and especially where there is little fall, the use of the surveyor's instrument is advisable, I have seen good work done with extemporised apparatus. A carpenter's level was fitted with sights attached to a board and mounted on two supports. One of the supports was raised or lowered as required to bring the bubble to the centre. Readings could then be taken. If a fall of 1 in 400 was desired, successive readings on a graduated staff at intervals of 22 yards had to show a difference of very nearly 2 inches.

Much criticism has been directed against the practice, which was common many years ago, of placing drains at a depth of 4 or more feet in strong soils. In the majority of cases the ineffectiveness of these deep drains is due, not to their being too deep for the land, but to the condition at some time of the watercourses into which they were intended to empty. Two winters ago, in connection with an Unemployment Relief Scheme in the Sheffield district, it was necessary to deepen an old and overgrown watercourse in order to obtain sufficient fall to carry away the water from an area of about 60 acres which were waterlogged, partly as a result, it was thought, of coal mining subsidence. On deepening the watercourse in question water began to pour from the mouths of old drains, whose outlets were about 5 ft. below ground level. The soil of the field in question was coal measures clay and owing to its wet and unproductive condition it had been allowed to run to "grass." In this as in many other cases of wet land, the source of the wetness was the seepage of water from dry topped lighter land situated at a higher level.

Milking.—If a cow's udder were merely a vessel or reservoir holding milk already secreted, it could make little difference to the yield or the composition of the milk whether the fluid was drawn quickly or slowly, provided that it was all got out. But the actual holding capacity of an udder is only a few pints; the bulk of the milk yielded by a cow is secreted during the act of milking, and both experience and actual experiments have shown that quickness of performing the operation has a con-

siderable effect on the activity of the gland. Probably it is not generally known that quickness of milking may make a difference of 0.5 per cent. in the fat content of a cow's milk; but in trials carried out by Dr. Crowther, even greater difference was directly attributable to this factor. In previous trials he had found that the quarter milked first always yielded the richest milk and that milked last always showed the lowest fat content; when teats were milked in pairs, the produce of the first pair was richer than that of the second pair, and when two milkers emptied all four quarters simultaneously, the cows yielded about 3 per cent. more milk, and the milk contained 0.12 per cent. more fat than when milked in the ordinary way.

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NOTES ON MANURES FOR NOVEMBER.

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Rothamsted Experimental Station.

Autumn Treatment of Grassland.—Much of our poor and medium grass is highly responsive to fertiliser treatment, for apart from deep seated causes of infertility such as bad drainage or excessive sourness, the required improvement is usually obtained by a moderate outlay on phosphates, and in some cases on potash also, while the good effects persist for several years.

Basic slag has long been the most popular agent for the improvement of heavy pasture land. Its early reputation was made on the poor boulder clays of Northumberland where the original value of the land for grazing purposes was strikingly increased by its use, while highly satisfactory—but perhaps not such spectacular—results were obtained on most types of heavy land throughout the country. The material which produced this effect was a Bessemer slag containing about 40 per cent. of phosphate, 85 per cent. or more of which was in a citric soluble form. The prevailing practice was to make the first dressing a heavy one of about 10 cwt. per acre, a dose which provided the equivalent of 200 lb. of phosphoric acid or 440 lb. of phosphate of lime. Under favourable conditions a big growth of wild white clover followed the application; the finer grasses increased at the expense of the coarser grasses and weeds; the pasture could carry a bigger head of stock and do them better than formerly, and the outlay was amply covered in the increased returns. After several seasons the early improvement generally showed signs of

falling off, and fresh applications of about 5 cwt. per acre of slag were then given at intervals of 3 or 4 years to maintain the land in its productive condition.

The common pre-war practice has been influenced by three factors in recent years :—(1) the basic slag itself may be different both in grade and in composition from the original type; (2) the value of ground mineral phosphates for use on grassland has been brought out: and (3) with the extended use of phosphates under varying soil conditions it has been found that additions of potash or of lime are sometimes necessary to produce the best results.

Present-Day Slags.—Owing to the almost complete change from the Bessemer to the open-hearth process of steel manufacture in this country, high-grade slag of 40 per cent. phosphate content now forms only a small fraction of the total output of basic slags, and the majority of farmers have to supply their needs in other ways. Although precise classification of basic slags is not possible without chemical tests, the bulk of the supplies may be roughly grouped as follows :—

1. Slags of 26-33 per cent. grade.
2. Slags of 18-25 per cent. grade.

Those in Group 1 may be regarded as closely akin to the pre-war high-grade slags in agricultural behaviour, and similar results may be expected from them provided that attention is paid to their percentage of phosphate when reckoning how much to give for a dressing, *i.e.*, 13 cwt. of a 33 per cent. slag will be required to supply the same amount of phosphate as 10 cwt. of a 42 per cent. slag.

Group 2 contains the so-called low-grade slags which may be further separated into two sections, high soluble and low soluble respectively, according as to whether the contained phosphate is largely soluble in the official citric acid solution, or whether only about one-third of the phosphate can be so dissolved. It should be noted, however, that the farmer is not usually in a position to make this distinction as the solubility of slags need not be stated by the merchant. The high soluble low-grade slags appear to be comparable with the high-grade slags when similar amounts of phosphate are applied, and in the case of a 20 per cent. slag this will involve the use of twice the dressing per acre that would be given if 40 per cent. material was available. As a result of many tests with slags of known solubility, it has been found that the most insoluble types while usually producing quite good results are less certain than the others, the greatest differences in favour of the soluble types being observed in dry

districts. In places where the rainfall is high, and on moist soils, these insoluble slags have often worked in much the same way as the others.

Mineral Phosphate.—With the change in the grade and quality of slag, attention has turned to alternative sources of basic phosphate, and experiments comparing finely ground phosphatic minerals with basic slag have been undertaken in many parts of the country. The materials which have received most attention have been North African rock phosphates containing about 58 per cent. of phosphate. In order to assist their availability the fineness of grinding is an important factor, and it is possible to obtain samples in which 80 per cent. of the total will pass through a sieve of 14,400 meshes to the square inch. Most experimenters have found that the mineral phosphates have very considerable value for grassland improvement. The chief conditions in favour of their action are : a moist climate, a soil which is strongly in need of phosphate, or rich in organic matter, and not abundantly supplied with lime. Under such circumstances they have usually been comparable with good basic slag in their effects. Under opposite conditions, dry climate, dry seasons, and on chalky soils they are slower to act than soluble basic slags. It should be noted, however, that Dr. Scott Robertson, in Essex, has obtained distinctly beneficial results from rock phosphates in this relatively dry area, results which only suffered by comparison with the better performances of more soluble phosphates.

It may be recommended therefore that on soils which need phosphate in moist districts, any kind of basic slag or finely ground mineral phosphate may be applied with fair confidence. Under drier conditions attention should be turned to the more soluble types of basic slags (in the absence of a solubility guarantee the best that can be done is to purchase the highest grade available), or to steamed bone flour, or in cases where the lime supply is satisfactory to superphosphate. To commence the improvement on land hitherto untreated the quantity to aim at will be about 10 cwt. per acre of 40 per cent. slag or its equivalent of other grades :—

Phosphate Content. per cent.	Dressing per acre. cwt.
20	20
30	13
40	10
50	8
60	6½

If it is impracticable to apply the full dressing good results could be expected from two-thirds of the above quantities, but

the phosphate supply would need renewing somewhat earlier. To maintain improvement, when as usually happens after four and five years the need of a fresh dressing is felt, about one-half of these amounts should suffice.

When Phosphates Fail to Act.—It is common knowledge that cases sometimes arise when phosphates give disappointing results. Some frequent causes of failure are worthy of notice. The bottom of the pasture may be so matted with bent grass that the runners of the wild white clover which it is hoped to stimulate may not be able to reach the soil. Heavy harrowing will often open the surface and give the clover a better chance, although in cases where there is much undecayed grass residues in the sole of the pasture a preliminary liming is usually necessary to promote the decay of this dead turf. The land may be too sour to support a good class herbage even when phosphates are supplied, a case which has been found common in parts of Yorkshire,* and if this is suspected the local advisory officer should be consulted before undertaking liming. A further cause for the failure of phosphates sometimes occurs through lack of a sufficient supply of readily available potash in the soil. This is much more likely to occur on the lighter soils than on heavier land, and also on land which is frequently mown rather than on land which is commonly grazed—for the hay crop removes potash from the soil whereas the potash removed by grazing stock is largely returned in the urine. A guide as to whether to use potash is obtained by making a trial in the field in question. A strip of kainit at about 4 cwt. per acre may be run across the field and kept under observations for the following season. The farmer is then in a position to decide whether he considers that the extra outlay on potash will be remunerative. In cases where potash is needed, autumn applications of manures supplying about 50 lb. of pure potash should be given every other year. This quantity would be provided by any of the following dressings per acre :—

4 cwt.	...	12½ per cent.	Kainit.
3½ "	...	14½ " "	"
2½ "	...	20 " "	Potash salts.
1⅔ "	...	30 " "	" "
1 "	...	50 " "	Muriate of potash.

* See this *Journal*, May, 1924, p. 133, and June, 1924, p. 251.

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	*Average Price per ton during week ending Oct. 23rd.* Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	13. 2	13. 0	12. 5	12.15	16. 5
„ „ Lime (N. 13 per cent.)	...	12.10	...	12.10	19. 3
Sulphate of Ammonia, neutral (N. 21.1 per cent.)	12. 9*	12. 9*	12. 9*	12. 9*	(N)11.10
Kainit (Pot. 20 per cent.)	3.10	3. 0	...	...	...
„ (Pot. 14 per cent.)	3. 0	2.15	2.15	2.15	3.11
Potash Salts (Pot. 30 per cent.)	4.15	..	...	4. 9	2.11
„ „ (Pot. 20 per cent.)	...	...	..	3. 2	3. 1
Muriate of Potash (Pot. 50–53½ per cent.) ...	9. 2	8. 2	8. 2	9. 2	3. 5
Sulphate of Potash (Pot. 48–51½ per cent.)...	11. 0	11. 5	11.2	11. 0	4. 4
Basic Slag (T.P. 34 per cent.)	...	...	3. 0§	...	...
„ „ (T.P. 30 per cent.)	...	...	.	2.15§	1.10
„ „ (T.P. 28 per cent.)	...	2.11§	...	2.10§	1. 9
„ „ (T.P. 26 per cent.)	...	2. 3§	...	2. 5§	1. 9
„ „ (T.P. 24 per cent.)	2. 9§	1.19§	1.18§	..	...
Superphosphate (S.P. 35 per cent.)	3. 9	...	3.17	3. 6	1.11
„ (S.P. 30 per cent.)	3. 2	2.17	3.10	3. 0	2. 0
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	8.15	8. 5	8. 5	8. 5	...
Steamed Bone Flour (N.¾, T.P. 60-65 per cent.)	6. 2†	6.15†	6. 5	5.12	...
Fish Guano (N. 6½-7, T.P. 10 per cent.) ...	...	...	...	9.15	...
„ (N. 7½-8½, T.P. 16-20 per cent.)	...	...	13. 0	...	...
Burnt Lump Lime	1. 8	1.13	1.18	2. 1§	...
Ground Lime	1.15	2. 1	2. 8	1.15§	...
Ground Limestone	1. 7	...	1. 4	1. 5§	..

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

§ Prices include cost of carriage from works to town named. Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire and London prices are for not less than 4-ton lots delivered within a limited area. Cost to purchasers in other districts will be greater or less according to the distances of different purchasers from the works.

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MONTHLY NOTES ON FEEDING STUFFS.

E. T. HALNAN, M.A.,

Animal Nutrition Institute, Cambridge University.

Barley as a Feeding Stuff.—In view of the present price of barley, a few notes on its merits as a feeding stuff may be of value. In this country barley is not used as a feeding stuff to any extent except as a meal for pigs. The comparative cheapness of barley is a sufficient reason for suggesting to stock-feeders and others that this material should be used for other stock as well as pigs. In the East barley forms the staple grain food for horses, and in Denmark a mixture of crushed

oats and barley is esteemed as a concentrated food for milch cows. It has, however, been stated that when used for horses barley is apt to give rise to colic and diarrhœa, but this idea may have arisen owing to the fact that the feeding barley given to horses and other stock consists of badly-matured and badly-conditioned grain that are of no use to the brewer for malting. Provided sound grain is used, there is no reason to anticipate dietary troubles by including it in a ration.

An average sample of barley has the following percentage composition :—Water, 14.0; protein, 11.0; oil, 1.5; fibre, 4.5; carbohydrates, 66.5; ash, 2.5; and contains 8.2 per cent. digestible protein, 1.2 per cent. digestible fat, and 64.5 per cent. digestible carbohydrates and fibre. Owing to the fact that the paleæ are adherent to the grain, barley contains a little more woody fibre than wheat. 100 lb. of barley contain approximately 1 oz. of lime, 12 oz. of phosphorus (calculated as P_2O_5) and $\frac{1}{3}$ oz. of chlorine. The nutritive ratio is 1 : 9, rather wide. and barley should therefore be fed in conjunction with a leguminous hay such as clover or lucerne when possible.

Method of Preparation and Feeding.—For pigs, the barley is fed in the form of a meal, and is justly esteemed as a pig feed, giving rise to a very good quality of carcase. For sheep or lambs, for cows and for horses, barley should be roughly crushed or rolled, since if fed whole the hard grains may escape digestion altogether. On the other hand, it is inadvisable to feed sheep on a finely-ground barley meal, since it has been found that barley meal pastes and forms a sticky mass in the sheep's mouth, causing it considerable inconvenience in attempting to masticate such material. In small establishments, where crushing machinery is not installed, barley should be soaked for some hours before feeding.

Quantities to Feed.—In the case of horses, barley can replace oats in the ration to the extent of one-third or one-half of the total ration. In the case of milch cows, a mixture of oats and barley, half and half, can be given freely, balancing the protein required by the addition of a protein-rich food, such as decorticated cotton seed cake. In the case of fattening cattle, as much as a stone of crushed barley a day can be fed.

The Rôle of Fibre in Feeding Stuffs.—It is now generally recognised by stockfeeders that, apart from the possible effect of minerals and vitamins, the feeding value of a feeding stuff depends largely upon the amount of digestible protein, oil, and starchy and sugary material it contains. Now, among other

DESCRIPTION.	Price per Qr. s. d.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	§ Starch Equiv. per 100 lb.	Price per Unit Starch Equiv. s.	Price per lb. Starch Equiv. d	§ Protein Equiv. %
Wheat, British	—	—	10 8	0 15	9 13	72	2/8	1·43	9·6
Barley, British Feeding	—	—	8 5	0 11	7 14	71	2/2	1·16	6·2
„ Canadian :—									
„ No. 3 Western	32/6	400	9 2	0 11	8 11	71	2/5	1·29	6·2
„ „ 4 „	31/0	„	8 13	0 11	8 2	71	2/3	1·20	6·2
„ „ Feed	28/0	„	7 17†	0 11	7 6	71	2/0	1·07	6·2
„ American	30/6	„	8 10	0 11	7 19	71	2/3	1·20	6·2
„ Russian	30/0	„	8 8	0 11	7 17	71	2/3	1·20	6·2
Oats, English, White	—	—	9 10	0 13	8 17	60	2/11	1·56	7·6
„ „ Black and Grey	—	—	9 0	0 13	8 7	60	2/9	1·47	7·6
„ Scotch, White	—	—	10 12	0 13	9 19	60	3/4	1·78	7·6
„ Irish, Black	—	—	8 0	0 13	7 7	60	2/5	1·29	7·6
„ Canadian :—									
No. 2 Western	31/0	320	10 17	0 13	10 4	60	3/5	1·83	7·6
„ 3 „	29/0	„	10 3	0 13	9 10	60	3/2	1·70	7·6
„ Feed	25/3	„	8 17‖	0 13	8 4	60	2/9	1·47	7·6
„ American	26/0	„	9 2	0 13	8 9	60	2/10	1·52	7·6
„ Argentine	27/3	„	9 10	0 13	8 17	60	2/11	1·56	7·6
„ Chilian	26/6	„	9 5*	0 13	8 12	60	2/10	1·52	7·6
Maize, Argentine	38/6	480	9 0	0 12	8 8	81	2/1	1·12	6·8
Beans, English Winter	—	—	10 0†	1 10	8 10	66	2/7	1·38	20·0
„ Chinese „	—	—	11 2*	1 10	9 12	66	2/11	1·56	20·0
Peas, Japanese	—	—	27 10*	1 6	26 4	69	7/7	4·06	18·0
Dari, Egyptian	—	—	12 10	0 14	11 16	71	3/2	1·70	7·2
Millers' Offals :—									
Bran, British	—	—	6 15	1 5	5 10	42	2/7	1·38	10·0
„ Broad	—	—	8 5	1 5	7 0	42	3/4	1·78	10.0
Middlings—									
Fine Imported	—	—	9 5	1 0	8 5	69	2/5	1·29	12·0
Coarse, British	—	—	8 2	1 0	7 2	58	2/5	1·29	11·0
Pollards, Imported	—	—	7 0	1 5	5 15	60	1/11	1·03	11·0
Meal, Barley	—	—	10 2	0 11	9 11	71	2/8	1·43	6·2
„ Maize	—	—	10 10	0 12	9 18	81	2/5	1·29	6·8
„ „ South African	—	—	9 5	0 12	8 13	81	2/2	1·16	6·8
„ „ Germ	—	—	9 10	0 18	8 12	85	2/0	1·07	10·0
„ „ Gluten Feed	—	—	9 15	1 5	8 10	76	2/3	1·20	19·0
„ Locust Bean	—	—	9 17	0 9	9 8	71	2/8	1·43	3·6
„ Bean	—	—	12 5	1 10	10 15	66	3/3	1·74	20·0
„ Fish	—	—	20 10	3 19	16 11	53	6/3	3·35	48·0
Linseed Cake, English 12% Oil	—	—	14 0	1 15	12 5	74	3/4	1·78	25·0
„ „ 10% Oil	—	—	13 7	1 15	11 12	74	3/2	1·70	25·0
„ „ 9% Oil	—	—	12 15	1 15	11 0	74	3/0	1·61	25·0
Soya Bean „ 6% Oil	—	—	12 10	2 10	10 0	69	2/11	1·56	36·0
Cottonseed Cake, English $5\frac{1}{2}$% Oil	—	—	8 0	1 12	6 8	42	3/1	1·65	17·0
„ „ Egyptian $5\frac{1}{2}$% Oil	—	—	7 12	1 12	6 0	42	2/10	1·52	17·0
Decorticated Cotton-seed Meal 7% Oil	—	—	12 7†	2 10	9 17	74	2/8	1·43	35·0
Ground Nut Cake 7% Oil	—	—	10 10†	1 14	8 16	57	3/1	1·65	27.0
Palm Kernel Cake 6% Oil	—	—	8 15	1 1	7 14	75	2/1	1·12	17·0
„ „ „ Meal 6% Oil	—	—	8 10‖	1 1	7 9	75	2/0	1·07	17·0
„ „ Meal 2% Oil	—	—	7 15	1 2	6 13	71	1/10	0·98	17·0
Feeding Treacle	—	—	7 2	0 9	6 13	51	2/7	1·38	2·7
Brewers' Grains :—									
Dried Ale	—	—	8 10	1 2	7 8	49	3/0	1·61	13·0
„ Porter	—	—	8 0	1 2	6 18	49	2/10	1·52	13·0
Wet Ale	—	—	1 4	0 8	0 16	15	1/1	0·58	4·8
„ Porter	—	—	0 18	0 8	0 10	15	–/8	0·36	4·8
Malt Culms	—	—	8 10*	1 12	6 18	43	3/3	1·74	16·0

* At Liverpool. † At Bristol. ‖ At Hull.

§ The figures in these columns have been corrected in accordance with the tables given in the Report of the Committee on the Rationing of Dairy Cows.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of September and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 1s. per ton. The food value per ton is therefore £8 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 5d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·29d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices:—N, 11s. 10d.; P_2O_5, 3s. 8d.; K_2O, 2s. 11d.

things, the digestibility of protein, oil and soluble carbohydrate present in a feeding stuff is influenced by the amount of woody fibre that is present. Thus, in the case of meadow hay, digestibility determinations have shown that, as a general case, the percentage digestibility of the protein present decreases as the percentage of woody fibre present increases. Thus, taking available digestibility determinations as given by Kellner, a hay containing 33.5 per cent. of fibre gave a protein digestibility coefficient of 45 per cent., a hay containing 26.3 per cent. of fibre gave a digestibility coefficient of 55 per cent., and a hay containing 19.3 per cent. of fibre gave a digestibility coefficient of 68 per cent. The capacity of stock to deal with woody fibre also varies. Sheep, cattle and horses can utilise feeding stuffs containing woody fibre much more efficiently than the pig. It is, therefore, very important for stockfeeders to watch very carefully, in making up rations, the content of crude fibre in the feeding stuffs used, and only to use for pigs such feeding stuffs as have a low fibre content. In purchasing compound feeding stuffs particularly, an analysis of the crude fibre content is essential if economy in feeding is aimed at. The declaration of oil and albuminoids, while useful for assessing the feeding value of feeding stuffs of a similar character, is of little worth in estimating the feeding value of compound meals and cakes where the content of crude fibre present is likely to fluctuate considerably.

Farm Values.—The "food values" entered in column 4 of the table given below have been calculated on a basis obtained by comparing the food value with the value of a similar number of units of starch equivalent and protein equivalent purchasable in the open market, as recommended by the Departmental Committee on Rationing of Dairy Cows. A full explanation of the system is given in the Committee's Report.*

The "food values" and prices in respect of the foods used as bases of comparison for the purposes of this month's calculations, are as follows:—

	Starch Equivalent.	Protein Equivalent.	Per Ton. £	s.	d.
Barley	71	6.2	8	10	0
Maize	81	6.8	9	0	0
Decorticated Ground Nut Cake	73	41.0	12	10	0
,, Cotton Cake ...	71	34.0	12	15	0

Add 10s. per ton, in each case, for carriage.

*Obtainable from H.M. Stationery Office, Adastral House, Kingsway, W.C.2, price 6d. net.

The cost per unit starch equivalent works out at 2.19 shillings, and per unit protein equivalent, 2.78 shillings. Applying these costs respectively to the starch equivalent values given in column 2 and the protein equivalent values in column 3, the "food values" entered in column 4 of the following table are obtained. In accordance with the recommendation of the Rationing Committee, these values may be taken as applicable to the ensuing four months, December to March, inclusive:—

FARM VALUES.

1 CROPS.	2 Starch Equivalent.	3 Protein Equivalent.	4 *Food* Value per ton, on farm.
1. *Roots.*	Per cent.	Per cent.	£ s.
Kohl Rabi	8	0·5	0 19
Mangels	7	0·4	0 16
Potatoes	18	0·6	2 1
Swedes	7	0·7	0 17
Turnips	5	0·4	0 12
2. *Green Foods.*			
Cabbage, drumhead	7	0·9	0 18
,, open-leaved	9	1·5	1 4
Kale, marrow-stem	9	1·3	1 3
Silage, Vetch and Oats ...	13	1·6	1 13
3. *Hay.*			
Clover Hay	32	7·0	4 9
Lucerne Hay	24	7·9	3 14
Meadow Hay, poor	19	2·9	2 10
,, ,, medium ...	31	4·6	4 0
,, ,, very good ...	40	7·8	5 9
Seeds Hay	24	4·9	3 6
4. *Straws.*			
Oat Straw	17	0·9	2 0
Wheat Straw	11	0·1	1 4
5. *Grains and Seeds.*			
Barley	71	6·2	8 13
Beans	66	20	10 0
Oats	60	7·6	7 12
Peas	69	18	10 1
Wheat	72	9·6	9 4

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MISCELLANEOUS NOTES.

The Storage of Fruit for Winter Use.

THE storage of fruit for winter use is a subject of wide interest, concerning alike the large fruit grower and the domestic head of the household. Many varieties are not sufficiently ripe to eat when picked, and need to be stored before they are fit for use or sale. Commercial growers store their fruit also in times of glutted markets, or when they believe that higher prices will be got later in the season. The small grower who grows for himself stores his fruit because he wishes to make his little supply last the longer, and the housewife who can buy cheaply stores against the winter-time, when fruit will be dear. Many of these folk have no properly constructed fruit store available for their purpose, and they use an outhouse, a cellar, or an attic; and good or bad storage may result according to the chance of their choice.

In choosing a place for a store and in packing for storage it is often forgotten that fruit are to be likened to living, breathing organisms, and that unless conditions agreeable to continued life are present they will decay. Another point is that some varieties of fruit become ripe so quickly after picking that little can be done by way of storage to keep them, except perhaps it be cold storage. These are such varieties as Beauty of Bath, Mr. Gladstone, Worcester Pearmain, Early Victoria, Stirling Castle and the Codling varieties. On the other hand, Cox's Orange Pippin, Rival, Barnack Beauty, Sturmer Pippin, Lane's Prince Albert, Newton Wonder, Bramley Seedling and Annie Elizabeth take several weeks after being picked to become ripe, and consequently store well. It is, then, necessary to make quite sure that fruit for ordinary storage is of the keeping kinds. It must also be healthy or diseases may develop in or after storage which will cause serious loss.

The preparation of fruit for successful storage ought to start during the growing season. At the beginning of it, and later if necessary, the trees should be sprayed against insect and fungus pests. The justification for this is that many experiments have shown that apples gathered from trees which have been efficiently sprayed are capable of being kept in storage with a much smaller percentage of loss than are apples from trees which have been left unsprayed.

The apple that will keep best in store is the one that is full grown, hard when picked, is unbruised and unblemished and

has the stem adhering. Other apples start at a disadvantage and may not keep.

The conditions most likely to result in successful storage apart from good growing are a moist atmosphere in the store, which should not be allowed to become stagnant; plenty of ventilation in the store to begin with, say, for the first three weeks, which should afterwards be reduced; and an even, cool temperature, and partial darkness.

A cellar provided with ventilation satisfies most of these conditions and is much more suitable as an apple store than an attic where the atmosphere is inclined to be too dry and the temperature so uneven that the fruit never assumes a stable resting condition, but shrivels and deteriorates. Outhouses can often be made into good stores fulfilling these conditions. Where there is an old chalk or gravel pit or a disused lime kiln, or where part of the store can be built underground, it should be tried and will usually be found successful. A building above ground should be thatched and the walls covered with good straw reed, Norfolk reeds, bracken or heather, or some other non-conductor of heat.

It is not absolutely necessary to fit up the inside of a storehouse with fixed shelves. These are convenient, of course, but they often, in time, become impregnanted with any fungus spores there may be about, and so may ultimately prove a disadvantage to good storage. The best results are obtained if each apple is wrapped in clean white tissue, or, preferably, in oiled paper, and then packed in apple boxes made of new wood. When full of apples, the boxes can be stacked in piles in the store, though it is advisable to leave a little space for ventilation between each box.

There is also the system of *cold* storage—temperature about 32° to 33° Fahrenheit. It is usually employed for large quantities of fruit which are to be kept a long time. Cold storage chambers exist in almost every large town, and fruit-growers would be well advised to explore the possibility of using them effectively and cheaply, though fruit cannot be expected to ripen in them.

As to pears, the unripe late pear is usually hard, dry, almost without flavour and very poor to eat; but in the process of ripening, the flesh becomes soft and melting, the juice plentiful, sweet and delicately flavoured. The storage conditions must be just right or the fruit will not ripen properly. Each pear should be wrapped separately in tissue paper and spread out in single layers in shallow boxes. Periodic inspection is imperative

because of the importance of knowing exactly when the fruit has reached a nearly ripe condition. It should then be taken into a room of warmer temperature so that the final changes taking place within the fruit may develop the full flavour characteristic of the variety. Pears ripen and pass to the sleepy condition so quickly that the observer must be ever on the watch if the best results are to be obtained. Pears which keep well in storage are Conference, Doyenne du Comice, Glou Morceau, Roosevelt and Winter Nelis. With the use of artificially cooled chambers even a variety such as William Bon Chrétien can be marketed in good condition fully six weeks later than its normal period.

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A Competition Essay on Cattle.

THE Council of the English Jersey Cattle Society are offering a prize of £10 for an essay, not exceeding 3,000 words in length, on the subject of "The Light-Weight Breeds of British Dairy Cattle—with special reference to the economical production of milk and butter fat." The competition, which is open to any University undergraduate or student at an Agricultural College or farm institute, will close on December 1st next. Full particulars regarding it can be obtained from the Offices of the Society, 19, Bloomsbury Square, London, W.C.1.

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Walnut Survey.

WITH the object of discovering superior varieties of walnuts suitable for cultivation in this country, the Ministry has instituted a survey of British Walnuts; and samples of nuts from various parts of England and Wales are being obtained for detailed examination. In order that the survey may be as comprehensive as possible, the Ministry will be obliged if persons who possess walnut trees which produce good quality nuts, and who are willing to allow samples of them to be taken, would communicate with the Secretary, Ministry of Agriculture and Fisheries. 10, Whitehall Place, London, S.W.1.

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Lectures by Rothamsted Staff.

DURING the forthcoming season it would be possible for members of the staff of this Institution whose names are appended to give a few lectures to Chambers of Agriculture and Horticulture, Farmers' Unions and Clubs, Agricultural Societies, Farm Workers' Organisations, etc., dealing with the experiments being carried on at this Station in regard to the subjects mentioned below.

As much notice as possible beforehand is requested, and an endeavour will be made to meet the convenience as to dates, and precise scope of lecture.

No fee will be charged for the services of the lecturer, but Associations would be expected to defray his travelling and out-of-pocket expenses and to make all necessary arrangements for the lecture.

All communications regarding lectures should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

1. Manuring, etc., for Farm Crops.	
Root Crops and Potatoes. Cereals. Grass Land. The Rotation. Management of Farmyard Manure. Liming.	Mr. H. V. Garner, M.A.
Green Manuring: its place in British Agriculture.	Mr. H. J. Page, B.Sc.
2. Soil Micro-Organisms (Bacteria, Protozoa, etc.).	
Lucerne Inoculation.	Mr. H. G. Thornton, B.A.
Life in the Soil.	Mr. D. W. Cutler, M.A.
3. Agricultural Botany.	
Weeds of Arable and Grass Land.	Dr. Winifred E. Brenchley, F.L.S.
4. Agricultural Chemistry.	
The Principles of Manuring. The Chemistry of Crop Production.	Mr. H. J. Page, B.Sc.
5. Soil Physics.	
The Principles of Soil Cultivation. Soil Moisture and Temperature, and their Control.	Dr. B. A. Keen, F.Inst.P. Dr. W. B. Haines, F.Inst.P.
6. Insecticides and Fungicides.	
Control of Wart Disease of Potatoes.	Mr. W. A. Roach, B.Sc.
Insecticides and Fungicides.	Mr. F. Tattersfield, B.Sc. Mr. C. T. Gimingham, F.I.C.
7. Entomology.	
Insect Pests.	Dr. A. D. Imms, M.A.
Horticultural, Market Garden and Orchard Pests.	Dr. J. Davidson, F.L.S.
Bee Keeping.	Mr. D. M. T. Morland, M.A.

8. Mycology.

Potato Diseases (Wart, Virus, etc.	Dr. W. B. Brierley, F.L.S.
Plant Diseases: their Causes and Control.	
Soil Fungi and Plant Growth.	
Fungus Pests of Crops.	

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Lectures on the Rothamsted Experiments.

DURING the forthcoming winter it would be possible for Mr. H. V. Garner, the Guide Demonstrator of the Institution, to give a few lectures to Chambers of Agriculture and Horticulture, Farmers' Clubs, Farm Workers' Associations, Agricultural Societies, etc., on the Rothamsted Experiments in regard to:—

1. Artificial Manures and their use on the Farm.
2. Practical Lessons from recent Field Experiments.
3. Useful Dressings for the Root Crops.
4. Modern Ideas on the Manuring of Potatoes.
5. The Manuring of Cereals.
6. Profitable Improvement of Grass Land.
7. Manuring a Rotation of Crops.
8. Chalking and Liming.
9. The Manure Heap: how to lose and how to use it.

For Students' Societies and similar bodies lectures could be arranged dealing with:—

1. The Planning and Carrying out of Field Experiments.
2. The Manurial Field Work at Rothamsted.
3. Some factors in Soil Fertility: an account of the work in the Rothamsted Laboratory.
4. The Nature and Use of the Newer Artificial Fertilisers.

It should be noted that it is not practicable to deal with more than one subject in a single lecture.

Associations desiring to avail themselves of Mr. Garner's services are requested to indicate the subject or subjects which would be of most interest to them, and the Institution would endeavour to arrange for same and would do its best to fall in with the convenience of those engaging him as to dates. As much notice as possible beforehand is requested.

No fee will be charged for Mr. Garner's services, but any Association engaging him would be expected to defray his travelling expenses and to make such arrangements for the lecture as may be necessary.

All communications regarding lectures should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden.

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The Agricultural Index Number.

A SLIGHT rise was recorded in September in the general level of prices of agricultural produce, the general average over the month being 57 per cent. higher than in the corresponding month of 1911-13, as compared with 56 per cent. above the pre-war level in August. In September, 1924, agricultural produce averaged 60 per cent. above pre-war, while in the corresponding month of 1922 and 1923 the average level was 57 and 56 per cent. respectively higher than in the base years.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.	1925.
January ...	200	183	75	68	61	70
February ...	195	167	79	63	61	67
March ...	189	150	77	59	57	65
April ...	202	149	70	54	53	58
May ...	180	119	71	54	56	57
June ...	175	112	68	51	58	55
July ...	186	112	72	53	52	51
August ...	193	131	67	54	59	56
September	202	116	57	56	60	57
October ...	194	86	59	51	63	—
November	193	79	62	53	64	—
December	184	76	59	56	63	—

Prices of corn declined during September, the reduction in the case of barley being very sharp. The average price of wheat throughout September was 3d. per cwt. lower than in August, and oats averaged 4d. per cwt. less on the month, but barley, in spite of the sharp fall during September, averaged 1s. 10d. per cwt. more than in August as a result of the comparatively high prices early in the month. Wheat and oats usually become cheaper at this time of the year, and as the reduction in September in the price of wheat was relatively less than in the corresponding month of 1911-13, the index number records an increase of 6 points, while the index figure of oats is unchanged. On the other hand, barley usually advances in price in September, but the rise of 1s. 10d. per cwt. was relatively greater than before the war and the index figure rose by 7 points. All classes of grain were dearer than in September, 1923, but with the exception of oats average prices were lower than in the corresponding month of 1924.

Fat cattle were slightly cheaper than in August, and the index number declined by 1 point to 53 per cent. above the basic years, the level of prices being practically the same as a year ago. Fat sheep also became cheaper and a reduction of 7 points was recorded in the index figure. Fat pigs advanced in value, and the index figures for bacon pigs and porkers were 14 and 9 points respectively higher than a month earlier. Fat sheep were much cheaper than in September, 1924, but fat pigs were considerably dearer.

Dairy cattle averaged about 8s. per head less than in the previous month. Store cattle and store sheep recorded a further slight decline in value, the index numbers falling to 37 and 90 per cent. respectively above the prices ruling in the corresponding month of 1911-13, but the advance in store pig prices was continued, the index number rising 18 points on the month. All classes of store stock, with the exception of store pigs, were cheaper than a year ago, but pigs at 75 per cent. above pre-war value were considerably dearer.

The average price of milk delivered under contract was rather higher on the month, and the index figure was 63 per cent. above pre-war. The seasonal increase in the price of butter and cheese was continued, but the index numbers were reduced 3 points and 1 point respectively as the advances were proportionately less than in pre-war years. Butter sold at about the same price as in September, 1924, but cheese was considerably dearer. Eggs, as is usual at this period of the year, were less plentiful and dearer, and the index number advanced 8 points on the month.

Heavy supplies of potatoes have been marketed, and prices have declined throughout the month, the average wholesale price for main crop potatoes being £5 13s. per ton as compared with £6 14s. 6d. for first early varieties which formed the bulk of the supplies marketed in August, and the index number shows a drop of 14 points to 53 per cent. above pre-war. As compared with September, 1923 and 1924, potatoes were nearly 15 and 25 per cent. respectively cheaper. Both clover and meadow hay advanced slightly in value, the index number rising 1 point, but hay is still only 4 per cent. dearer than in the basic years.

Fruit on the average was rather more than twice as dear as in pre-war years. Apples recorded a fairly substantial decline in price, but the index number was unchanged at about 55 per cent. higher than in the base years. Both pears and plums have been scarce and prices were about 130 and 160 per cent. respectively above those ruling in the corresponding month of 1911-13.

Vegetables were on the average rather dearer than in August, the general level of prices being about 70 per cent. higher than in pre-war years. Cabbage was slightly cheaper, but cauliflowers rose sharply in value and were double the pre-war cost, while both carrots and celery were about 70 per cent. dearer than in the corresponding month of 1911-13. As compared with September, 1924, fruit and vegetables were about 10 and 40 per cent. respectively dearer.

Index numbers of different commodities during recent months and in September, 1923 and 1924, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	1923.	1924.	1925.			
Commodity.	Sept.	Sept.	June.	July.	Aug.	Sept.
Wheat ...	19	61	62	47	47	53
Barley ...	30	107	38	34	62	69
Oats	30	38	38	34	43	43
Fat cattle ...	45	54	50	48	54	53
Fat sheep ...	72	100	93	79	76	69
Bacon pigs ...	48	38	54	51	52	66
Pork pigs ...	59	37	53	52	56	65
Dairy cows ...	52	59	47	50	50	46
Store cattle ...	27	44	43	42	39	37
Store sheep ...	109	130	115	115	91	90
Store pigs ...	95	29	55	53	57	75
Eggs... ...	75	71	52	61	67	75
Poultry ...	67	75	61	75	58	58
Milk	67	58	55	57	62	63
Butter ...	56	72	57	73	73	70
Cheese ...	74	42	78	70	78	77
Potatoes ...	75	99	76	43	67	53
Hay	32	1	3	0	3	4

Farm Workers' Minimum Wages.

A MEETING of the Agricultural Wages Board was held on 6th October, at 7, Whitehall Place, S.W.1, the Chairman, Lord Kenyon, presiding.

The Board considered notifications from Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and proceeded to make the following Orders carrying out the Committees' decisions:—

Buckinghamshire.—Minimum and overtime rates of wages for male workers and minimum rates for female workers from the 1st Nov. when the current Order expires) to the 28th Feb., 1926. The new Order provides that the weekly rate in the case of male workers aged 21 and over shall be for the coming winter 31s. per week of 48 hr. (instead of 30s. per week of 50 hr. in summer and 48 in winter as at present). The weekly rates for male workers under 21 remain unchanged and are payable for a week of 48 hr. during the winter period. No change is made for female workers, the rate for such workers aged 18 and over being 6d. per hr.

Gloucestershire.—From the 12th Oct. continuing the current minimum and overtime rates of wages for male workers and minimum rates for female workers up to the 11th Oct., 1926. The rates in the case of male workers aged 21 years and over are: head carters, 34s. 6d. per week of 58 hr. in summer (first Monday in March to last Sunday in Oct.) and 36s. per week of 60 hr. in winter (remainder of the year); head shepherds or head stockmen, 36s. per week of 60 hr.; under carters, 32s. 6d. per week of 54 hr. in summer and 34s. 6d. per week of 57 hr. in winter; under shepherds or under stockmen, 34s. 6d. per week of 57 hr. Other adult male workers 30s. per week of 50 hr. In the case of female workers the rate is 5d. per hr. for workers of all ages.

Hampshire and Isle of Wight.—From the 12th Oct. continuing the current minimum and overtime rates of wages for male workers and minimum rates for female workers up to the 28th Nov., 1925. The rates in the case of male workers aged 21 years and over are 30s. per week of 51 hr. in summer (first Monday in March to the first Sunday in Nov.) and 48 hr. in winter (remainder of the year). In the case of female workers the rate for workers aged 18 years and over is 5d. per hr.

Leicestershire and Rutland.—From the 1st Nov. continuing the current minimum and overtime rates of wages for male and female workers until further notice. The rates in the case of male workers aged 21 years and over are for Leicestershire 34s. and for Rutland 32s. 6d., in both cases for a week of 54 hr. The rate for female workers aged 18 and over is 5d. per hr in both counties.

Norfolk.—From 11th Oct. continuing the current minimum and overtime rates of wages for male and female workers up to the 10th Oct., 1926. The rates in the case of male workers aged 21 years and over are 29s. per week of 50 hr. in summer (first Monday in March to first Sunday in Nov.) and 28s. per week of 48 hr. in winter (remainder of the year), with, in addition, in the case of workers employed wholly or mainly as teamsmen, cowmen, shepherds, sheep-tenders or bullock-tenders, inclusive weekly sums to cover all time in excess of those hours spent in the care of and attention to stock. These additional sums are, for teamsmen, cowmen and shepherds 5s. 6d. per week, and for sheep-tenders and bullock-tenders 4s. 6d. per week, except that in the case of cowmen, bullock-tenders and sheep-tenders under 18 years of age who are not in sole charge of animals the inclusive weekly sums are reduced to 3s. In the case of female workers the rate for workers aged 18 and over is 5d. per hr.

Nottinghamshire.—From the 1st Nov. continuing the present minimum and overtime rates of wages until further notice. The rate in the case of male workers aged 21 years and over is 32s. per week of 50 hr. and for female workers aged 18 years and over 5d. per hr.

Oxfordshire.—From 1st Nov. continuing the current minimum and overtime rates of wages for male workers and minimum rates for female workers up to the 30th Oct., 1926. The rate in the case of male workers aged 21 years and over is 30s. per week of 50 hr.

in summer (first Monday in March to last Saturday in Oct.) and of 48 hr. in winter (remainder of the year). In the case of female workers aged 18 years and over the rate is 6d. per hr.

Wiltshire.—From 12th Oct. continuing the present minimum and overtime rates of wages for male workers and minimum rates for female workers up to the 11th Oct., 1926. The rate in the case of male workers aged 21 years and over is 30s. per week of 50 hr. and in the case of female workers aged 18 years and over 5d. per hr.

Copies of the Orders in full can be obtained on application to the Secretary of the Agricultural Wages Board.

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Produce of Hops.

PRELIMINARY Statement showing the estimated total production of hops in the years 1925 and 1924, with the acreage and estimated average yield per statute acre in each county of England in which hops were grown; and the average yield per acre of the ten years 1915-1924.

COUNTIES, &c.		Estimated Total Produce.		Acreage returned on 4th June.		Estimated Average Yield per Acre.		
		1925.	1924.	1925.	1924.	1925.	1924.	Average of the 10 years 1915-24.
		Cwt.	Cwt.	Acres.	Acres.	Cwt.	Cwt.	Cwt.
KENT	East ...	63,000	70,000	3,693	3,659	17·1	19·2	11·9
	Mid ...	88,000	109,000	5,418	5,411	16·2	20·2	12·9
	Weald ...	101,000	125,000	7,150	6,897	14·2	18·1	11·3
	Total, Kent	252,000	304,000	16,261	15,967	15·5	19·1	12·0
HANTS		13,000	16,000	1,045	1,037	12·3	15·3	10·1
SURREY		2,200	4,200	179	216	12·2	19·5	9·0
SUSSEX		28,000	44,000	2,413	2,389	11·6	18·2	10·5
HEREFORD		40,000	50,000	4,186	4,101	9·5	12·3	8·6
WORCESTER ...		19,000	25,000	2,059	2,080	9·3	11·9	9·1
OTHER COUNTIES*		950	1,200	113	107	8·4	10·8	7·0
TOTAL ...		355,000	444,000	26,256	25,897	13·5	17·1	11·0

* Salop, Gloucester and Berkshire.

NOTE.

The yield per acre of hops this year is estimated at 13½ cwt., or 2½ cwt. more than the average of the ten years 1915-24. The crop picked much heavier than was anticipated at the beginning of September. As compared with the record crop of last year the yield is lighter by about 3½ cwt. per acre. In Kent, yields of a ton or more per acre were obtained from some gardens, and

in East Kent, where crops were heaviest on the whole, the average was slightly over 17 cwt. per acre. Over the whole of Kent the yield per acre averaged 15½ cwt., or 3½ cwt. above the ten years' mean. Hampshire crops yielded 12¼ cwt. per acre, or 2¼ cwt. above average, and those of Sussex about 11½ cwt., or 1 cwt. above average. Yields were lighter in the western counties, being 9¼ to 9½ cwt. per acre, but those of Hereford exceeded the ten years' average by nearly 1 cwt. In Worcester the yield was only slightly greater than the decennial mean.

The total production is estimated at 355,000 cwt. or 90,000 cwt. less than last year's high figure, but nearly 100,000 cwt. above the average production of the ten years 1915-24.

* * * * * *

Sale of Poultry Quills.

SINCE the prohibition of the importation of swan quills by the Importation of Plumage (Prohibition) Act, 1921, the demand for such quills, which are used for the making of artists' brushes and fishing tackle, is greater than the available supply. The quills are shed naturally once a year, and the Ministry wishes to draw the attention of those who have such home supplies to the fact that a profitable outlet exists for swan quills and others which can be used in place of them. There is a demand for goose, turkey, and duck quills, although the importation of these is not prohibited, and also for feathers when supplied in quantities of not less than 1 cwt. The Ministry has a list of merchants who desire supplies of quills and feathers which will be furnished to any inquirers who have supplies for sale. Such inquiries, or letters from merchants who wish to be placed upon the list, should be addressed to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

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NOTICES OF BOOKS.

British Weeds.—(Richard Morse, F.R.H.S., and Ray Palmer, F.E.S., F.Z.S., London: Ernest Benn, Limited. Price 10s. 6d. net.) The subject of weeds and their destruction is one of great importance for farmers, who are faced with the eradication of weeds of one sort or another at all times from about March to December, and on occasion in the other months also. Taking the world over there is a very considerable literature dealing with weeds, but our British works on the

subject are few, and if it were only because one would wish to create interest in the losses caused by weeds, the volume by Messrs. Morse and Palmer, published earlier in the year, is a welcome addition. The general arrangement of the matter in this book is quite good and readily followed, and the suggested control measures are usefully summarised. It may be suggested, however, that certain highly troublesome weeds, such as wild onion and wild oat, might have been more fully treated. The proposed experiment with fish and copper sulphate in a bucket of water (p. 165) is of doubtful utility. The illustrations are somewhat uneven in quality, some being poor and not showing the characteristics of agricultural importance. The volume should prove useful to those who are interested in weed destruction.

The Romance of the Fungus World.—(R. T. & F. W. Rolfe, Chapman & Hall, Ltd., London. Price 12s. 6d. net.) Books dealing with mycology are not, as a rule, of the readable order. The more serious text-book is full of technicalities and consequently beyond the scope of the ordinary " man in the street," while attempts at popular dissertations are apt to be more or less limited to the larger, conspicuous forms, and to treat these chiefly from a gastronomic standpoint. The authors of the present work are to be congratulated on having produced a very fascinating account of their subject; while at the same time their pages are full of scientific information of the kind to lead the student to ask for more.

The reader is first of all beguiled by two most interesting chapters in which are collected a mass of references to fungi in mythology, folklore and fiction. Only when interest has been thus aroused is the pill of hard facts as to structure, etc., administered. The two chapters dealing with structure, characteristics and mode of existence of fungi are perhaps the least satisfactory in the book, but here considerations of space, as well as the needs of the more technical reader, have compelled the authors to give only the merest outlines of the subject. Some of the statements as to the physiology of fungi are rather sweeping, as, for instance, that light is not essential for development (p. 42)

The later chapters, comprising about two-thirds of the book, are devoted to a general consideration of the relations between fungi and man, namely, in agriculture, in industry, in medicine, and as articles of food.

The authors lay stress on the enormous pecuniary losses due to the ravages of fungi, figures being given from the reports of various countries. It is cheering to read that in one respect this country does seem to be ahead of the United States in practice, namely, in the treatment of railway ties by creosoting under pressure. Figures are quoted showing the annual mortality of untreated ties in the United States, but unfortunately comparative figures for this country, which would have been most instructive, are not available.

In the section dealing with the depredations of saprophytic fungi, in addition to the well-known timber rots and the moulds attacking articles of food, some mention might perhaps have been usefully included of the fungi which cause damage to other manufactured goods, as, for instance. cotton fabric and sheet rubber.

On the whole the information given in these chapters is unusually full and gives evidence of considerable care in searching the available literature.

There is much to praise in this effort to popularise a little understood subject, and the pleasant finish and numerous beautiful photographs add considerably to the attractiveness of the book.

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International Year Book of Agricultural Statistics for 1924-25.—The International Institute of Agriculture at Rome has just published its annual volume on agricultural statistics. It contains a comprehensive series of tables relating to the area, production, trade and prices of the chief agricultural products, live stock, fertilisers and other chemical products useful in agriculture, in various countries. This edition includes the tables inserted in the Year Book for 1923, with the addition of data for 1924, some figures for 1925, and supplementary information for earlier years not available in time for the preceding issue. Some new tables have also been added. The Year Book (which contains nearly 500 pages) can be obtained at the offices of the Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1, price 8s.

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Agricultural Exhibition in Egypt.—With reference to the notice in last month's issue of this *Journal* (p. 670) regarding the forthcoming Agricultural and Industrial Exhibition at Cairo, information has since been received from the Egyptian Charge d'Affaires in London to the effect that the Exhibition will open on 20th February, 1926, and continue until 20th March, instead of closing on 6th March as originally stated. Intending Exhibitors should make application before 1st December, 1925, to the Royal Agricultural Society, P.O.B. No. 63, Cairo. A copy of the Regulations may be obtained on application to the Department of Overseas Trade (Exhibition and Fairs Division), 35, Old Queen Street, London, S.W.1.

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Foot-and-Mouth Disease.—There has been a serious recrudescence of disease since the October issue of the *Journal*. Disease was confirmed at High Wycombe, Bucks., on 25th September, and at Preston, near Weymouth, on 29th September, but with the exception of an extension to neighbouring premises in the latter area these outbreaks did not extend, and all restrictions imposed in connection therewith have been withdrawn.

On 17th October, disease was confirmed near Haywards Heath, Sussex.

On 19th October, the existence of disease was reported at Hazel Grove, Stockport, and at Rotherham, Yorks, W.R.; disease in both cases being confirmed. On 21st October, disease was found to exist at Haslingden, Lancs., and at Stanley, near Chippenham, Wilts.

In the course of the next few days, disease spread rapidly over parts of Lancs. and Wilts., involving the application of restrictions to large areas in Yorkshire, Lancashire, and Cheshire.

On 25th October, another new centre was established by the confirmation of disease at Exhall, near Coventry, and a day later disease was found to exist at Great Oxendon, near Market Harborough.

The position in these areas up to and including 26th October is as follows:—

Area.	Number of Outbreaks in Area.	Date of last Outbreak.
Sussex	3	26th Oct.
Cheshire	2	"
Yorks. W.R.... ...	7	"
Lancs.	25	"
Wilts.	14	"
Warwicks.	3	"
Northants.	1	"

These bring the total number of outbreaks from 1st January, 1925, to 26th October (inc.) to 83, of which 25 were confirmed prior to 25th September.

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SELECTED CONTENTS OF PERIODICALS.

Dairying.

Circumstances Influencing the Yield and Quality of Milk, *J. Mackintosh.* (Trans. Highland and Agr. Soc., Scotland, xxxvii (1925), pp. 126-145.) [63.711.]

Mineral Nutrients in the Rations of Dairy Cows, *J. B. Orr et al.* (Scottish Jour. Agr., viii, 3 (July, 1925), pp. 312-318.) [63.711 : 043.]

Veterinary Science.

Concerning Veterinary Research, *Sir Stewart Stockman.* (Jour. Roy. Agr. Soc., England, 85 (1924), pp. 78-90 + 11 pl.) [37 : 619(42).]

Bovine Tuberculosis with Special Reference to Eradication Methods, *S. H. Gaiger.* (Scottish Jour. Agr., viii, 3 (July, 1925), pp. 235-251.) [614.54.]

Sheep Scab, *Sir Stewart Stockman.* (Trans. Highland and Agr. Soc., Scotland, xxxvii (1925), pp. 1-22.) [619.3.]

Poultry.

The Nutritive Requirements of Poultry v. Importance of the Mineral Content of the Ration, *J. B. Orr et al.* (Scottish Jour. Agr., viii, 3 (July, 1925), pp. 263-269.) [63.651 : 043.]

Engineering.

Electric Power in Agriculture, *C. Dampier-Whetham.* (Jour. Roy. Agr. Soc., England, 85 (1924), pp. 246-270.) [537; 63.17.]

Tractor Costs, 1923-24, on a Farm in East Kent, *H. W. Kersey* and *D. Brown.* (Scottish Jour. Agr., viii, 3 (July, 1925), pp. 282-288.) [63.175.]

Economics.

The Economics of Agriculture with Special Reference to the Lag between Expenditure and Receipts, *C. Dampier-Whetham.* (Jour. Roy. Agr. Soc., England, 85 (1924), pp. 122-159.) [338.1; 338.5.]

The Economics of Production on Grass and Arable Farms. Gold Medal Research Essay by *H. J. Vaughan.* (Jour. Roy. Agr. Soc., England, 85 (1924). pp. 205-245.) [63.191; 338.58.]

Under-Cultivation and the Remedy, *Noel Buxton.* (Contemporary Rev., (July, 1925), pp. 9-17.) [338.1(42); 338.99.]

Feeding the World, *Sir A. D. Hall.* (Scientific Agriculture, v, 12 (Aug., 1925), pp. 361-368.) [338.9.]

Rating and Taxation of Agricultural Subjects in Scotland, *J. H. Milne Home.* (Trans. Highland and Agr. Soc., Scotland, xxxvii (1925), pp. 93-103.) [336.2(41).]

The Miller's Margin. A Study of Prices of Wheat, Flour and Offals, *A. W. Ashby.* (Jour. Roy. Agr. Soc., England, 85 (1924), pp. 109-121.) [63.311 : 31; 664.6.]

Growth and Organisation of the Canadian Grain Trade, *E. H. Godfrey*. (Jour. Roy. Agr. Soc., England, 85 (1924), pp. 1-31 + 7 pl.) [63.31 : 38.]

The Nation and the Land, *N. Skelton*. (Quarterly Review, July, 1925, pp. 190-208.) [333.5(42).]

Why has Agricultural Co-operation Failed? *L. F. Easterbrook*. (19th Century Review, September, 1925, pp. 335-345.) [334(42).]

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ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

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Spicer and *Pegler*.—Farming Records and Accounts. (140 pp.) London: H.F.L. (Publishers), Ltd., 17, Ironmonger Lane, Cheapside, 1925, 10s. 6d. [657(02).]

Cohen, J. B., and *Ruston, A. G.*—Smoke: A Study of Town Air. (Effects of Soot and Sulphuric Acid on Vegetation; The Plant as an Index of Smoke Pollution.) Second Edition. (110 pp.) London: Edward Arnold, 1925, 8s. 6d. [614.7(02); 58.11(02).]

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Live Stock.

Curtis, R. S.—The Fundamentals of Live Stock Judging and Selection. Third Edition. (472 pp.) London: Henry Kimpton, 1925, 15s. [63.6(064).]

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NOTES FOR THE MONTH.

Foot-and-Mouth Disease.

As this issue of the *Journal* goes to press, 187 outbreaks of foot-and-mouth disease on separate premises have taken place in a little more than eight weeks. In the exposure of animals at markets in the incubative stage of the disease lies the greatest potential danger of the spread of infection, and outbreaks having been confirmed in widely separated areas, in some of which markets have been involved, the Ministry has felt it imperative to take such precautionary measures as are possible to prevent the development of a still more serious situation. For this reason the Ministry came to the conclusion that it was necessary to impose a partial standstill Order over the Midlands and South of England (see p. 872). This came into force at midnight on 16th November, and it is hoped that it will not be necessary to continue its operation for more than a few weeks. The Ministry is aware of the inconvenience and hardship which may be experienced by many connected with the live-stock industry through the operation of this Order, but it is strongly of opinion that this measure, which is essentially a preventive one, is necessary in the interests of the country as a whole as well as of agriculture in particular.

As a further precautionary measure the Ministry has also issued an Order prohibiting hay or straw used for packing merchandise and certain other packing materials, which have been under suspicion as a source of infection, from being brought into contact with animals in Great Britain (see p. 872).

One of the difficulties met with in the endeavour to stamp out this most infectious disease, is the tendency on the part of farmers and smallholders to feed as swill to pigs scraps of imported raw meat and vegetables. It is impossible for the Ministry to control this danger, but pig-keepers should realise in their own interest, as well as that of the country generally, that no imported produce should be fed to pigs unless it has first been boiled. It is hoped that farmers will strictly observe all the precautions advised in the Ministry's leaflets on the subject of this disease. It is the work of the Ministry to collect and sift all the available

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information, and to advocate measures based upon the most scientific methods of dealing with this scourge. An intensive campaign is carried out in each new infected area to ensure that all farmers in the locality receive copies of the Ministry's leaflets, and that all local authorities have a sufficient supply of them.

Short of discovering a preventive of foot-and-mouth disease, slaughter, however objectionable, is the only way at present available of safeguarding the community from a widespread outbreak. The heavy cost is justified in the interests of agriculture. An isolation policy is impossible in this country; not only are the necessary buildings lacking wherein to isolate the stock; but it is impossible to restrict the movements of human beings who, it has been proved, can and do carry the disease. In France, where the disease has got out of hand, and slaughter is not enforced, it is estimated that the farmers lose millions of pounds sterling every year. No fewer than 2,351 fresh outbreaks were notified there during the first three weeks of October last, while in September there were 7,823 cases in Holland and 3,658 cases in Denmark.

It is desirable here to controvert misleading suggestions that farmers are making large profits by so-called "compensation" for their slaughtered animals. As a matter of fact elaborate arrangements are in force for valuing the cattle before slaughter; and it must not be forgotten that farmers repeatedly suffer severe loss in not being able to sell their stock for long periods, by reason of the restrictions which it is necessary to impose in districts where outbreaks occur. They also suffer loss of usual profit from keeping stock on account of the slaughter of their animals and their inability to buy-in fresh stock for a considerable period.

The word "compensation" is a misnomer, as the Ministry does not pay compensation. In the public interest animals on infected premises are compulsorily bought for slaughter, and of the amount paid a certain proportion is recovered in respect of salvage of healthy carcasses.

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Diseases of Animals Acts Report.

THE Chief Veterinary Officer of the Ministry, Sir Stewart Stockman, has issued a Report* on the work under these Acts for the year 1924. One of the principal items is the history of foot-and-mouth disease in that year, when there were no less than 1,440 outbreaks, which involved upwards of 42,000 cattle, 28,000 sheep and 17,000 swine, slaughtered at a

*Obtainable from H.M. Stationery Office, Adastral House, London, W.C.2, price 1s. 6d.

cost of nearly £1,400,000. The position in regard to the other animal diseases. notably sheep scab, as to which the Ministry proposes the inauguration of a new policy, is also fully stated.

The information as to the importation of Canadian store cattle may provide an item of public interest. During the year 45,853 cattle were landed from Canada as stores, compared with 27,665 landed during the nine months ended 31st December, 1923. 13,262 were slaughtered in the landing places as being fat and 61 casualties occurred amongst the animals on the voyage, or 1.3 per thousand. Half the total of the animals were landed at Birkenhead and half of the remainder at Glasgow. The figure of 45,853 cattle landed as stores from Canada compares with 34,645 fat cattle landed for slaughter from all permitted sources —namely, 12,841 from Canada, 21,064 from the United States, and 740 from South-West Africa. In addition, there were 4,250 sheep imported from Iceland Among the fat cattle imported from America there were 155 casualties, or approximately ½ of 1 per cent. When the length of the voyage is taken into account this appears to provide a not unsatisfactory indication that the animals are carried under proper conditions. The Report deals also with the transit of fat and store stock from Ireland, and the importation of foreign animals for exhibition or for other exceptional purposes.

The shipments of exported horses show that 25,642 were sent to the Continent of Europe after passing the veterinary examination required at the port. All such horses must be fit to travel and also fit to work without suffering.. 4,626 horses which were submitted for shipment were rejected, and four of these were immediately slaughtered by order of the Port Veterinary Inspector as being unfit to be kept alive without cruelty.

An interesting account of the outbreak of foot-and-mouth disease in the United States during this period is given in the Report, from which it appears that in the course of it 116,739 animals were slaughtered and compensation paid to the amount of £2,360,000.

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Baby Beef Production.

Journal readers will find much to interest them in the stimulating and suggestive article on "Baby Beef Production" in this *Journal*, p. 779. The modern tendency in milk production is in the direction of winter calvings. The official milk recording year begins on 1st October, and it is generally recognised that cows calving in autumn or early winter produce more milk in a lacta-

tion than those calving in spring or summer. Winter prices for milk are considerably higher than summer prices, and with the idea of taking full advantage of the increased returns, winter dairymen, as a rule, dispose of their bull calves at birth and rear only, if at all, their best heifer calves. The supply of bull calves is therefore apt to exceed the demand, and it was with the object of exploring alternative methods of disposal that the Hertfordshire Institute set about the calf-rearing experiments described in the article.

The public demand is now for small joints, whether of mutton, pork or beef, and it is generally recognised as a sound principle in business to supply what the public wants in a form in which it is most appreciated. Considerable progress in this direction has been made in respect of lamb, small mutton and pork, and while in regard to beef also, maturity is generally reached at a much earlier age than formerly, it is not yet customary to eliminate an intervening store period.

While the production of "baby beef" has been written and talked about for many years, and also practised to a limited extent, there are very few economic data available on the subject. The article in question deals faithfully with this aspect, and if the number of animals so far dealt with is comparatively small, enough information has been obtained to warrant further trials both by those responsible for experiment stations and by farmers themselves.

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Refrigerated Beef, Mutton and Lamb.

THE burden of the Linlithgow Committee's findings may be said to be this, that, in the new circumstances of world competition, a knowledge of the marketing and distributive processes at the disposal of home and competing produce is essential to the home producer. Only when thus informed can he adapt his methods of production, the goods he produces and the preparation of these goods for market, to the needs of the buying public. It is fitting, therefore, that the first Report* on commodity marketing to appear in the Ministry's Economic Series of publications should be an account of the trade in refrigerated beef, mutton and lamb, since the imported meat trade was outside the official scope of the Linlithgow Committee and did not receive attention at that time. Nor have subsequent

* Report on the Trade in Refrigerated Beef, Mutton and Lamb (Economic Series, No. 6). Obtainable from H.M. Stationery Office, Adastral House, Kingsway, W.C.2. Price 1s. 6d., post free 1s. 7½d.

reports on meat, namely, those of the Royal Commission on Food Prices and of the Imperial Economic Committee, examined, in close detail, the machinery of the distributive system: the first of these was mainly concerned with costs and profits, the second with the position of the Empire producer.

There is evidence that the Report now under review is meeting a long-felt demand in the trade for an authoritative, concise and cheap account of its exceedingly complicated affairs. It is to be hoped that it will prove of equal interest to the home producer, for whose information it was primarily prepared. Its relevance to the marketing and distribution of live stock and fresh meat in this country is obvious. In the words of the Report:—

> "The large-scale production, processing and distribution which characterise the trade in refrigerated meat in the great exporting countries is not without lessons applicable, with due adjustment, to the smaller farms, the infinitely smaller flocks and herds and the mainly individual butchering which mark the home-killed meat trade in this country. The price obtained for a steer in the country districts of England and Wales is necessarily affected by conditions ruling in the distant Argentine; similarly, English lamb prices are influenced by conditions in, say, New Zealand. Again, the methods of distribution pursued by the importing firms which have brought "dressed" meat into the very heart of the English countryside are bound to react on the marketing of home produce. Hence the marketing of home-produced meat must needs take note of the marketing of imported meat, and the present position and structure of this great international industry which supplies roughly half the total quantity of beef, mutton and lamb consumed in this country, must be of interest to all who profit—or suffer—by the cheapness of its products. Similarly, as markets become world-wide, knowledge confined to one country, is not, of itself, a sufficient guide for intelligent production and marketing. Information must be co-extensive with the whole producing and marketing field."

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Land Settlement in England and Wales.

UP to the end of 1914, nearly 13,000 small holdings had been created under the provisions of the Small Holdings and Allotments Act of 1908, but the ensuing four years of war practically prevented further progress, and the post-war conditions rendered it impossible to provide holdings to any considerable extent without incurring loss, whereas the Act of 1908 required that all small holding schemes, broadly speaking, should be self-supporting. To allow for the altered circumstances, and to enable the considerable demand of ex-Service men for holdings to be met, the Land Settlement (Facilities) Act was passed in 1919, removing the financial restriction on the

operations of Councils of counties and county boroughs in this direction, and providing that all losses reasonably or necessarily incurred by the Councils up to 31st March, 1926, should be borne by the State. At that date the estates are to be taken over by the Councils on a self-supporting basis, the capital loss incurred through the purchase and equipment of land at the inflated post-war prices being, in effect, written off. This post-war scheme was intended primarily for the settlement of ex-Service men, and, although civilians were not barred, the 1919 Act required that preference should be given to the ex-Service applicants.

From the passing of the Land Settlement (Facilities) Act to the end of 1924, 16,000 new small holdings have been provided by Councils on some 250,000 acres of land at a capital cost of over £15,000,000. The average price paid for land in the post-war schemes has been about £42 10s. per acre as compared with £32 17s. 6d. in pre-war settlement. Although the increase is mainly accounted for by the rise in land values, the post-war land is regarded as of rather better value than that purchased before the war; but this difference in price is practically a negligible cause of the scheme being uneconomic, this result being attributable to the high rate of interest on loans, the sharp rise in the cost of building and repair work, and the increased cost of management as a result of higher post-war salaries. Holdings, too, have been equipped to a much larger extent with a dwelling house and farm buildings, 2,749 new houses being erected in the post-war period compared with 744 before the war. The adaptation and repair of existing farmhouses and buildings, the erection of new buildings, and the provision of requisite roads, water supply and fencing, also necessitated considerable expense. It can be claimed, however, that while expenditure has been kept as low as possible, the new cottages and farm buildings erected are of a substantial character and, as regards design, by adhering to good proportion and the elimination of expensive features, are admitted, in the architectural world, to be a considerable advance on much of the rural housing before the war. The cost of equipment in the post-war programme amounts to over £5,000,000, or about one-third of the whole cost of the scheme.

How the tenants have fared on the new small holdings is a matter of no less interest than the creation and equipment of the holdings themselves. As regards the pre-war settlers the position is "eminently satisfactory." They had the advantage of a rising market during their early years of settlement and

benefited from the high war prices. The post-war settlers encountered very different conditions, experiencing bad seasons in 1921 and 1922 as well as the general fall in agricultural prices. No one with any knowledge of agricultural affairs since the war would imagine that they could have made good to the same extent as the pre-war holders. The number of failures is not definitely known, but is estimated at from 10 to 12 per cent. of the total number of men provided with holdings; of those now in possession the number likely to fail is thought to be small and there is no longer any cause for anxiety as to the future of the majority. Although the estimate indicates a higher proportion of failures than was experienced among the pre-war settlers, the number cannot be regarded as high, having regard to the extremely difficult conditions the ex-Service settlers had to face and to the fact that, in the general anxiety to do everything possible for the ex-Service men, a certain number were accepted as tenants who would never have been supplied with holdings in the earlier days. It is in fact a matter for surprise that so high a proportion have succeeded. The grit and determination that have carried the men through are well illustrated in the numerous instances of successful ex-Service tenants given in the full report on "Land Settlement in England and Wales, 1919-1924," which has just been published by the Ministry, and which can be obtained from H.M. Stationery Office, price 2s. 6d. This is a very comprehensive document, covering many sides of the question, and containing much valuable information for those interested in this subject.

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Research Monographs.

THE Ministry has undertaken to publish a series of monographs, the purpose of which is to give, in the language of everyday life, an account of work at the Agricultural Research Institutes of this country, and to explain the bearing of the results of research upon practical agriculture.

The first monograph of the series is entitled "Studies Concerning the Handling of Milk,"* and was prepared by Dr. Stenhouse Williams and the staff of the National Institute for Research in Dairying. That book has already reached a second edition, and the welcome given to it encourages the hope that the subsequent monographs will receive a like cordial reception.

* Research Monograph No. 1, obtainable from the Ministry. Price 1s., post free.

The second monograph, written by Dr. F. H. A. Marshall and Mr. J. Hammond, is based upon research into the physiology of reproduction in farm animals, conducted at the Animal Nutrition Institute at Cambridge. The title of the work is "The Physiology of Animal Breeding with Special Reference to the Problem of Fertility."* The importance of the subject to farmers and stock-breeders needs no emphasis. A proper understanding of the conditions governing the fertility of the animals with which they are concerned is essential to the conduct of their business. There is no reason why every breeder should not become acquainted with the important results of modern investigation. Except for the preliminary physiological descriptions which are indispensable to the understanding of the rest of the volume, the monograph is entirely practical in its bearing. There are 9 illustrations, and separate sections are devoted to the mare, the cow, the ewe, the sow, and the smaller farm animals.

Several other monographs are in course of preparation, including one on Wheat Breeding Investigations at the Plant Breeding Institute, Cambridge, by Professor Sir Rowland Biffen.

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Insect Pests of Crops, 1922-1924.

THE Ministry has just published a Report on the Occurrence of Insect Pests of Crops in England and Wales during the years 1922, 1923 and 1924,† being the fifth report of the series dealing with the incidence of insect (and other invertebrate) pests which are harmful to farm, fruit and garden crops. The object of these reports is to place upon permanent record those facts which ought to be recorded for the information of posterity, apart from the immediate interest of such facts. The present report differs from its forerunners in certain respects and includes new sections such as those dealing with "foreign introductions" and developments in methods of control.

The outstanding features of the three years under review were: (1) the damage done by Frit Fly, and to a lesser extent by Gout Fly during 1922; (2) the outbreak of fruit pests, notably aphides and caterpillers in 1923; and (3) the remarkable absence of most epidemic pests in 1924—for which there can be little doubt that the weather was responsible.

* Research Monograph No. 2. Price 2s., post free.

† Miscellaneous Publications No. 49, obtainable from the Ministry's Office, 10, Whitehall Place, London, S.W.1, price 1s. 6d. net (post free).

The completion of the Ministry's scheme for the appointment of advisory entomologists in each of the agricultural provinces has resulted in an increased knowledge of the distribution of pests in several areas, but even more information as to the commercial importance of most pests would still be very welcome, and it is hoped that farmers and fruit growers will, to an increasing extent, place their practical experience at the service of the advisory entomologists at the college centres of their province. For this purpose the Report contains a map showing the situation of the collegiate advisory centres and the counties forming the provinces which they serve.

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Agricultural Unemployment Insurance.

MEETINGS of the Departmental Committee on Agricultural Unemployment Insurance were held on 29th and 30th October, the Chairman, Sir Henry Rew, K.C.B., presiding. Evidence was given by Messrs. T. Sinden, Ben Ford and W. Avis on behalf of agricultural workers in various districts, by Messrs. W. Hyde, J. W. Harrison and W. Wood as representing the National Federation of Rural Approved Societies, by Mr. C. Elithorn as representing the Insurance Unemployment Board, and by Lieut.-Col. O. E. d'Avigdor-Goldsmid, the Chairman of the Tunbridge Wells Employment Committee.

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Property Acts, 1922 and 1924.

THE RT. HON. EDWARD WOOD, M.P., Minister of Agriculture and Fisheries, appointed in October a Committee to advise on the following matters :—

(1) The fee to be prescribed as payable to a steward of a manor, or to the Land Registrar, as the case may be, under Section 129 (2) and 131 (2) of the Law of Property Act, 1922, on an endorsement on an assurance of a certificate as provided by Section 129 (2), (4) and (8) of the said Act.

(2) The fee to be prescribed under Section 129 (6) of the said Act as payable to the steward of a manor on a certificate by him as to the payment of fines, reliefs, heriots, and fees payable in respect of any transaction and rents, including arrears, if any, as therein provided.

(3) The fee to be prescribed under Section 131 (1) and (2) of the Law of Property Act, 1922, as payable to a steward of a manor or the Land Registrar, as the case may be, in respect of transactions effected after the commencement of the said Act.

The Committee will consist of Sir C. Fortescue-Brickdale, Mr. H. W. Knocker, and Mr. C. G. May, together with Mr. P. W. Millard, and Mr. C. Wood-Hill, both of the Ministry of Agriculture and Fisheries.

Sir C. Fortescue-Brickdale will be Chairman, and Miss R. Skene Smith, of the Ministry, Secretary of the Committee.

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Allotments Act, 1925.

THE following Regulations, entitled the Allotments (Approved Societies) Regulations, 1925, were made by the Treasury on 10th November, 1925, under Sub-section (8) of Section 2 of the Allotments Act, 1925, which section authorises the Public Works Loan Commissioners to lend money to approved societies for the purpose of purchasing land to be used as allotments :—

(1) The rate of interest which may be paid by an approved society upon any share or loan capital raised after the date of these Regulations shall not exceed the rate of 6 per cent. per annum, such rate being a gross rate calculated before deduction of income tax.

(2) The distribution of profits amongst members of an approved society shall be limited in any year to the payment of a dividend not exceeding the rate of 5 per cent. per annum upon any share capital of the society for the time being subscribed and paid up, such rate being a gross rate calculated before deduction of income tax.

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Conference on Potato Manuring.

IN view of the importance of the potato crop, and the influence of manuring on both yield and quality, a conference on the manuring of this crop was held at the Rothamsted Experimental Station on 20th November. The Chair was taken by the Rt. Hon. Lord Clinton, and the proceedings were opened by Sir John Russell, who gave a brief exposition of the general principles involved. Messrs. J. C. Wallace, R. W. Wheldon and T. Eden then gave some account of experiments conducted respectively in Lincolnshire, the Northern Counties, and at Rothamsted. Great interest was shown by a large gathering representing all concerned in the various aspects of potato growing, and a keen discussion, opened by Lord Bledisloe (Parliamentary Secretary to the Ministry), followed. It is proposed to give a substantial account of the papers and discussion in the next issue of the *Journal*.

BABY BEEF PRODUCTION.

J. Hunter-Smith, B.Sc.,
Principal of the Herts Institute of Agriculture.

The past 50 years have seen a great change in the methods adopted for the speedy fattening of most of our farm stock, until early maturity and quick returns have now become general. With pigs and sheep, the modern method of growing and fattening simultaneously is found in its most intensive form, but with cattle an intervening store period is still very common. In the former cases it would appear that the public demand for lamb and pork met with a ready response from the farmer, who doubtless found the new system economically advantageous; in the latter case, developments have been much slower.

The position has, however, now been reached when the public show in an unmistakable manner, a definite partiality for a particular type of beef. Small joints constitute modern requirements, and the neat little animals which can supply them are everywhere in request. It is impossible to assume that the changed attitude of the public, in respect of any of the above products, is based on a scientific knowledge of food values or even on a new standard of economy. The reasons for the change in demand, which has occurred at the same time in several countries, are doubtless many and varied, and need not be dealt with here.

The object of this article is, rather, to try to impress on the farmer the importance of recognising the state of the market for his beef products, and at the same time to present some results and figures which appear to indicate that, as in the case of pork and lamb, the changed demand may be capable of being turned to the producer's advantage.

For some years "baby beef" production has been much talked about, but the writer is not aware of any definite data on the subject. It is true that a few farmers here and there have made a speciality of "baby beef," but neither their methods nor the extent of their financial success appears to be known. It seems, therefore, appropriate to raise the subject in a concrete form by publishing a few records which have been carefully kept at the farm attached to this Institute during the past three years. It is hoped in this way to focus the farmers' attention on modern tendencies in beef production and to open up a subject which merits much more detailed investigation.

Beef Production in England.—The bulk of the beef produced in this country arises from two sources:—

(1) From animals bought in as stores to be fattened off in yards on arable farms.

(2) From cattle fattened on grass on the grass farms in the Midlands and elsewhere.

These animals are usually from 2½ to 3½ years of age when marketed. They provide excellent beef of the large-joint type which, though of better quality than imported meat, is still greatly affected in selling price by foreign competition.

Perhaps the best quality beef produced in quantity in this country comes from farms in the north of England and east of Scotland. The native Aberdeen-Angus or a cross of this breed, provides the best foundation for meat production, resulting in a special trade of considerable dimensions. The animals are usually marketed at about 21 months of age, and supply a product of great uniformity and of the highest quality. Without a definite organisation, a graded material is supplied which is much sought after and commands a special market.

More recently, however, attention has been given to the production of still younger beef under the name "baby beef." This class of product is obtained from animals which have been intensively fed from birth, and which reach a weight of 8 to 9 cwt. at from 12 to 18 months of age. From the point of view of public taste, there is no doubt of the popularity of meat of this kind; it supplies small joints and the meat is tender and juicy. How far the consumer is well advised in his choice, from the point of view of food value for cost, is a different matter. There seems to be little information on this aspect of the question, apart from a bulletin* from Minnesota which merits careful study.

One criticism offered by the connoisseur in meat, is that baby beef lacks the real flavour of beef; he calls it neither good veal nor good beef. On the other hand, there is always plenty of competition for beasts of this kind, indicating acceptability of the meat to the majority of consumers. This fact has apparently been recognised by the Smithfield Show authorities who, for the last year or two, have provided special classes for fat beasts under 15 months of age.

Baby Beef Production at the Herts Institute.—It is important, in reporting the result of an investigation, that the con-

* Bulletin No. 193, University of Minnesota.

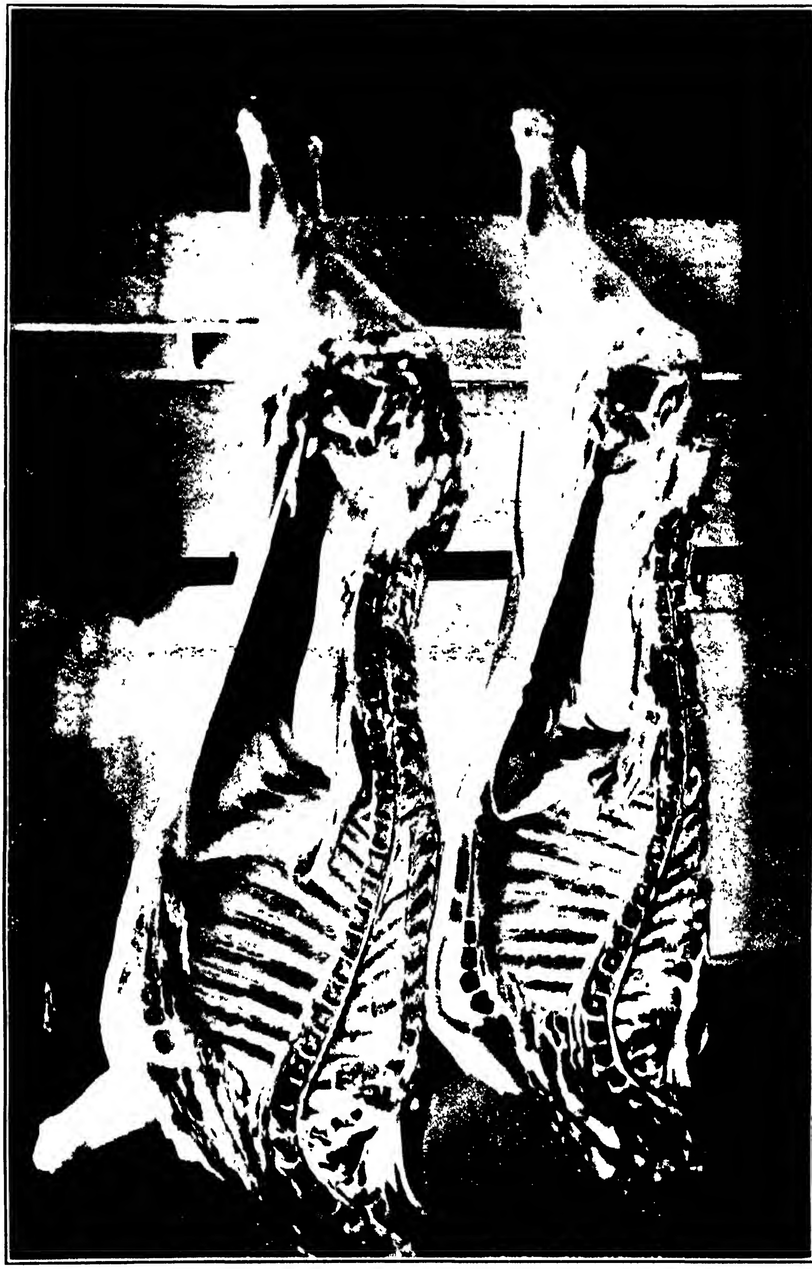

FIG. 1. Sides of Beef. *Left*, 3 years old, and *right*, 16 months old.

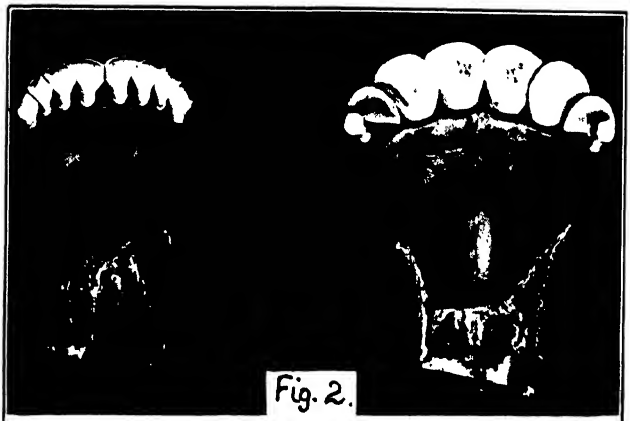

Fig. 2.
Incisor Teeth.
Left. 16 months old.
Right. 3 years old.

Fig. 3.
Sirloins.
Left. 16 months old.
Right 3 years old.

Fig. 4.
Back Rib Joints.
Left, 16 months old.
Right. 3 years old.

Fig. 5.
Shins.
Left. 16 months.
Right. 3 years old.

ditions under which the results are obtained should be specified, as under a different set of circumstances very different results may ensue. At the farm attached to this Institute, a herd of 20 dairy Shorthorn cows is maintained. These cows are all recorded, and in the past year or two have averaged about 700 gallons per head. The herd is really in the early stages of grading up; all the cows are non-pedigree, and are mated with a pedigree dairy Shorthorn bull.

Milk is the main object in view, with cream and cream cheese as profitable side-lines. Although the herd is not yet licensed, the standard of Grade A (T.T.) is reached and an enhanced price of 3d. to 4d. per gallon over the fixed minimum is obtained. All good calves are reared, the heifers to come into the herd and the bull calves to make " baby beef." Each calf is suckled by its dam for 4 days only, and is thereafter reared on the pail. Calf rearing is facilitated by the existence of good boxes, while young stock are housed in covered yards.

The cropping of the farm is regulated to provide a limited supply of green food practically all the year round, while silage from a steel silo provides succulent food in winter. Lucerne cut green is the main source of green food in summer, while oats and tares, cabbage, kale or mangolds are available for other periods.

Heifer calves for dairy purposes are turned out to grass in the ordinary way, but " baby beef " calves are kept under cover from birth until they go to the butcher.

Summarising the conditions, the important points are (1) that all calves suckle for 4 days only and are then pail-fed, using the minimum quantity of new milk, and (2) that the production of baby beef is, under the circumstances described, simply a means of utilizing a by-product, namely, bull calves, on a milk selling farm.

Preliminary Trial.—The first trial in the production of young beef was of a preliminary nature. Three calves out of dairy Shorthorn cows and sired by beef bulls, were used. These calves were reared from birth at the Institute on the lines indicated below.

Each of these animals did well, all making prime beef. Approximate costs, however, indicated that the margin of profit was small; in fact it appeared necessary to reduce costs by shortening the period of indoor feeding. With this impression in mind, 7 more calves were reared, fattened and disposed

of at an average age of 16 months. Details of the system of management adopted together with cost records, are now given. The results obtained are summarised below :—

	Blue-Grey Heifer	Roan Bullock.	Black Bullock.
Age when sold	81 weeks.	80 weeks.	85 weeks.
	cwt. qr. lb.	cwt. qr. lb.	cwt. qr. lb.
Live weight	9 3 14	10 1 0	10 0 21
Dead weight (in 8-lb. stones)	77 stones.	86 stones.	82¼ stones.
Percentage dead weight ...	55.7 per cent.	59.9 per cent.	57.8 per cent.
Price	£30 16s. 0d.	£34 8s. 0d.	£32 0s. 0d.
Price per stone	8s. 0d.	8s. 0d.	7s. 9d.

Results in 1924-25.—The seven calves used were out of commercial dairy Shorthorn cows by a pedigree dairy Shorthorn bull. Three of the dams were heavy milking cows, while the other four were only moderate milkers. The same bull sired all the calves, and this bull has a good milk pedigree though his ability to influence his daughters for milk production has not yet been proved. Two of the calves were heifers weighing at birth, 70 lb. and 79 lb. respectively—weights which compare with an average of 75½ lb. for 19 heifer calves at the Institute. The bull calves weighed at birth, 86, 92, 98, 106, and 101 lb., and these figures are well above the average of 86½ lb. for 20 bull calves during the last few years.

Each calf was suckled by its dam for 4 days, and thereafter, was pail-fed. No calf was allowed more than 30 gallons of new milk, and the average per calf was 25 gallons. Whole milk was gradually replaced by separated milk, each calf consuming an average of 55 gallons of this. Along with the milk a mixture of linseed cake meal and middlings in equal parts, was fed in the form of a gruel, while crushed oats with 5 per cent. of fish meal added was fed *ad lib.* As the calves grew older, hay and roots were introduced, and the concentrates consisted of linseed cake, crushed oats and fish meal till the calves were about 6 months old. A small proportion of fish meal was always included in the rations.

From 6 to 12 months, hay, silage and roots were varied with green food such as oats and tares, lucerne and cabbages. The linseed cake and crushed oats remained at 1 lb. each per head, but palm kernel meal and maize gluten feed were added, feeding quantities increasing from 3 lb. per head to 6 lb. per head of mixed cake and meal per day. For the last 4 months, bean meal and maize meal were added and the amount finally

reached was 8 lb. per head. All the animals were disposed of direct to the butcher, except the two out of "Maude" and "Mona," which were purchased by the same butcher at the Christmas market.

The progress made, together with the final weights and prices, are shown in the following table:—

Calf out of	Maude.	Mona.	Rose.	Beauty.	Beryl.	Iris.	Patricia.	Average.
Sex	(Heifer).	(Bull).	(Bull).	(Bull).	(Heifer).	(Bull).	(Bull).	
Date of birth	27/8/23	3/9/23	21/9/23	29/9/23	30/11/23	11/1/24	24/1/24	
Weight at birth	70 lb.	86 lb.	92 lb.	98 lb.	79 lb.	106 lb.	101 lb.	99 lb.
" " 32 wks.	455 "	553 "	525 "	574 "	490 "	469 "	469 "	505 "
" " 1 year	714 "	833 "	840 "	875 "	679 "	820 "	735 "	785 "
" " 64 wks.	868 "	1,008 "	959 "	1,037 "	833 "	1,050 "	952 "	958 "
Age at killing in weeks	68	67	64	73	70	65	67	68
Live weight at killing	8c. 1qr.	9c. 3qr.	9c. 1qr.	10c. 1qr.	8c. 1qr.	9c. 1qr.	9c. 3qr.	9c. 1qr.
Carcass weight in 8-lb. stones	61	73	74	85	64½	76	75	72½
Percentage dead weight	52.8	53.5	57.1	56.5	55.8	57.2	54.9	55.3
Daily live weight gain from birth to slaughter	1.8 lb.	2.3 lb.	2.0 lb.	2.2 lb.	1.7 lb.	2.1 lb.	2.1 lb.	2.0 lb.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Price of beast	27 6 3	32 14 0	30 16 8	35 8 4	25 16 0	30 8 0	30 0 0	30 6 0
Price per stone	8 11½	8 11½	8 4	8 4	8 0	8 0	8 0	8 4½

Throughout the trial, the animals were weighed regularly and at the same hour on each occasion, but they were not fasted before being weighed. This applies also to the final live weights before slaughter. The average live weight of the 7 beasts before slaughter was 9¼ cwt., but the steers averaged within 6 lb. of 10 cwt. The rate of live weight increase from birth was the very creditable one of 2.0 lb. per head per day (steers 2.14 lb., heifers 1.75 lb.).

The prices obtained ranged from 8s. to 8s. 11½d. per stone of 8 lb. dead weight.

Comparison with 3-year-old Bullock.—The steer out of Patricia was retained a month longer than necessary in order to provide material for an exhibit at the County Show. A prime 3-year-old bullock was obtained at this time and the

two animals were killed together. The relative dead weight and prices of these two beasts were as follows---the average figures for the 7 baby beef animals being added for comparison :—

	Carcass weight. 8-lb. stones.	*Price.* £	s.	d.	*Price per stone.* s.	d.
Steer out of Patricia	75	30	0	0	8	0
Purchased 3 year-old	94½	37	0	0	7	10
Average of 7 baby beef steers	72½	30	7	0	8	4½

Photographs of the carcasses of these two animals are shown in Fig. 1, while in Figs. 3, 4 and 5 are given illustrations of joints from both beasts. The relative ages of the animals are well seen from their teeth, which are also illustrated (Fig. 2). These joints, on exhibit at the county show, attracted a great deal of interest, and a preference was unanimously expressed for the young beef.

The relative weights of equivalent joints from each beast were as follows :—

	Baby Beef Joints. Weight. lb.	oz.	*Three-Year-Old Joints.* Weight. lb.	oz.
Sirloin	8	7	9	15
Wing-rib	6	11	8	9
Back-rib	4	9	5	13
Shin beef	9	3	10	6

The corresponding joints in the two cases were valued at the same figure by the butcher.

A remarkable fact, which was much commented on, was the small differences in weights between the joints of the two types of animals. Unfortunately, it was not possible to determine the proportion of bone to meat, although it was obvious that such a comparison would have been to the advantage of the younger beast.

The results obtained in this trial have proved a source of great interest to farmers who saw the animals and to everyone who inspected the actual joints. On the one hand, surprise was expressed at the rapid growth the animals made in spite of the method of rearing and the limitation of milk in early life, while on the other hand the quality of the carcass and the excellence of the joints were freely commented on.

Balance Sheet.—It is now necessary to refer to the balance sheet, which is given below. First of all it must be pointed out that every precaution was taken to ensure accuracy in the figures. The concentrated foods were weighed out weekly and a record kept of the green food consumed. All home-grown

HERTFORDSHIRE INSTITUTE OF AGRICULTURE.
"OAKLANDS," ST. ALBANS.

BABY BEEF ACCOUNT.
(From August 27th, 1923, to June 1st, 1925.)

Dr.

	t.	c.	q.	lb.	£ s. d.	£ s. d.
To Value of 7 Calves as born at £1 per head						7 0 0
,, Purchased foods—						
Linseed cake ...	2	7	0	0	31 14 10	
Beans		9	3	14	5 0 3	
Oats	2	5	2	0	22 13 2	
Middlings		9	1	14	4 4 10	
Maize gluten ...		2	2	0	1 5 9	
Fish meal		7	2	14	5 16 11	
Barley		1	1	0	15 0	
Gram		2	2	0	1 10 6	
Palm kernel meal ...		7	0	14	2 11 1	
Maize meal		11	2	14	7 5 0	
						82 17 4
,, Home grown foods—						
Lucerne	10	10	0	0	7 10 0	
Hay	10	4	2	0	27 1 10	
Silage	2	3	1	0	2 13 5	
Roots . ..	31	1	0	0	30 17 6	
						68 2 9
,, Milk—						
175 gal. whole milk at 1s. 6d. per gal.					13 2 6	
385 gal. sep. milk at 2d.					3 4 2	
						16 6 8
,, Labour						9 10 0
,, Overhead charges						5 0 0
,, Balance, being profit						51 12 6
						£240 9 3

Cr.

	£ s. d.
By Manurial value of food consumed	28 0 0
,, Sales: 7 Bullocks	212 9 3
	£240 9 3

food was charged at cost of production. Milk was charged at full market price, while an apportionment for labour and overhead charges has been included. Exception might be taken to the valuation of good calves at birth at £1 per head. If this figure is considered too low, even for an unwanted dairy by-product, or if calves at a higher price were purchased, the final profit per head will be correspondingly reduced. The credit side of the account, in addition to the income from the sales of the beasts, includes a figure which represents the actual manurial value of the foods consumed. The profit of approximately £7 per head is certainly very suggestive. If such a result can be obtained under milk-selling conditions there would appear to be no doubt about the future of baby beef production.

* * * * * *

RURAL COMMUNITY COUNCILS.

GRACE E. HADOW.

The following article was written by Miss Grace E. Hadow for publication in The Nineteenth Century and After. *August,* 1925, *and is reprinted here by permission of the authoress and of the Editor, to whose courtesy the Ministry is indebted. The subject dealt with is of great interest and importance to all who are concerned with rural development, rural economy and rural well-being.*

IN those far-off days when parish councils were new, their begetters looked fondly to them for the regeneration of village life. Now at last were we to

> . . . see the people having a strong hand
> In framing their own laws : whence better days,

if not " to all mankind," at least to us who live in English villages. The result tempts one to quote further :

> . . . juvenile errors are my theme.

I know one parish council whose sole recorded activity was, in a spasm of energy, to put white posts along a bridge over the village ditch " 'Tisn't safe if a man's coming 'ome a bit fresh of a Saturday night," complained one councillor, and his colleagues agreed. Another, fired with youthful enthusiasm, passed a resolution calling upon Queen Victoria to resign, but added a rider—for they were a kindly and considerate folk—that she should be allowed a pension of thirty shillings a week " as she wasn't used to doing for herself." At the present day I doubt if any parish councils are so enterprising: the difficulty

is usually to induce anyone to attend an election, or to do anything if elected. And indeed the elections are often a farce. "I always get on," said a parish councillor recently, "because my name begins with 'B.' The names of candidates are read out alphabetically, and each name is voted on by show of hands. No one likes to offend a neighbour by not voting for him, so all the early letters score. No 'W' has a chance."

Ask the first half-dozen villagers you meet what are the powers of a parish council, a district council, or even the county council, and the chances are you will find complete ignorance. Nor is the matter much better with regard to boards of guardians and school managers. A friend of mine recently asked the village grocer if he knew who were the school managers. "Well," he said, "the vicar, he asked me to be on something, but I don't rightly know what it is."

The fact is that English local government is carried on by a comparatively small number of public-spirited individuals in spite of the complete apathy and ignorance of the vast majority of those who elect them. "I have sat for nineteen years on the county council," said a county councillor who had been asked by the women's institutes in his district to support the adoption of the Public Libraries Act, "and this is the first time any of my constituents has shown the slightest interest in anything I do." As a rule the county council is elected on one cry, and one only, "Keep down the rates," and is then abused by a few zealots, eager for individual reforms, because public services are skimped.

There is one way, and one only, to remedy this: to educate people to understand their powers and responsibilities as citizens; to make them realise that you can get nothing without paying for it; and to induce them to consider public budgets as carefully as private. Our trouble in the past has been the cleavage between statutory authorities and the general public. Swift's cynical plea for the retention of religion, because if men cannot have a God to blame if anything goes wrong they will blame the Government, has not lost its sting. We grumble at the roads, at the lack of village nurses, at the rare visits of school dentists, at the inadequate provision for elder children in many village schools; and we do more than grumble—we rise to impassioned denunciation—when we discuss the rates. It never occurs to us that we cannot have it both ways, or that local authorities are not malevolent abstractions bent on reducing us to ruin and at the same time on making our passage to the workhouse as un-

comfortable as possible, but men of like passions with ourselves, our fellow-citizens and fellow-ratepayers, whom we elect to carry out our wishes.

To many of us in the country elections are still something alien and remote. I well remember an election in the early days of women's institutes, when the retiring committee sat on the platform in a shy and smiling row and the president pointed to each one in turn and said: "Now we will elect Mrs. Blank; and now Miss So-and-So," and so on through the list. And many of us feel that our responsibilities end when once we have cast our vote. Women's institutes and the newer form of men's clubs are doing much to obviate this. Country men and women are learning the forms of public business; they are losing the inarticulateness which made it impossible for them to ask a question in public, and the sensitiveness which made them feel a question asked of them to be an insult. In managing their own social and recreational affairs they are getting something of the training which public school and university life provide, that give and take which is not the least important element in education. What we need is a closer union between the voluntary and the statutory authority. No country can be governed by Government alone.

> We cannot afford to wait for everything to happen from above as a result of Government initiative. . . . The voluntary groups and associations of a local or federal character in the domain of industry, national economy, particularly in the domain of daily custom, are destined to play as big a part. . . . Voluntary associations of the kind can only be welcomed. They mark the awakening of the public activities of different sections of the community. . . A genuine leadership of creative organising . . . must aim at discovering suitable ways of utilising the constructive energies of individual groups, persons, and co-operative units, and must base itself on the increasing independent activities of the masses.

There are those who fear that co-operation between voluntary and statutory authorities will lead to the shelving of responsibilities by the statutory bodies. "Public services should be performed by public servants," they say. To such, the words of Trotsky quoted above should bring comfort. If Bolshevism itself cannot dispense with the enthusiasm and driving power of voluntary associations, Governments less absolute may safely encourage them. There are others, officials and committee members, who say that no formal or recognised union is required, since already they know all that is necessary about their own area, and the well-intended efforts of voluntary societies are more hindrance than help. Anyone who has ever held an official

position must have some sympathy with these. We all know the nuisance of being taught our own business by people who are imperfectly acquainted with it. But if the object of local government is the welfare of the locality, then surely the more people who take an intelligent interest in it the easier will be the work of those responsible. It is in this belief that certain recent experiments in county and village organisation have been attempted.

After the war a number of societies became seriously concerned with problems of village life. They realised that new interests had been aroused, new stirrings were making themselves felt, new methods were needed. and they set about the task in various ways. All, however, found certain initial difficulties, and chief among them lack of transport, of village halls, and want of co-ordination and co-operation between village and village. County councils were in many cases offering facilities of which villages were not availing themselves; villages were needing just the things offered, but did not realise how to obtain them. Official language must needs have a certain legal precision which renders it wholly unintelligible to the laymen, and county council regulations, until they are translated, mean nothing to the average villager.

In some cases voluntary societies were being assisted by the county council; in others not. In some cases societies were working in harmony; in some they were ignorant of each other's existence; in a few they were antagonistic. In no case was the ground even approximately covered.

In several different counties there arose independently and almost simultaneously the idea that it might save time, energy and money, and prevent misunderstandings, if representatives of the statutory and voluntary bodies concerned could be induced to meet each other at regular intervals and discuss the problems in which they were interested. In this way rural community councils were born, and in December, 1921, the National Council of Social Service (which was already engaged in forming similar councils of social service in towns) called a representative conference at Oxford to thrash out the whole question. A list of the bodies represented at that conference indicates the kind of co-operation which its promoters had in mind. The Ministry of Agriculture, the Development Commission, and the Adult Education Committee of the Board of Education sent representatives: so did the County Councils' Association and the Association of Directors and Secretaries of Education, the National Union of

Teachers, and the Association of Assistant Masters in Secondary Schools; other voluntary societies included the National Federation of Women's Institutes, the Young Men's Christian Association, the Workers' Educational Association, and the Village Clubs' Association. The Carnegie United Kingdom Trust and the Horace Plunkett Foundation were also represented. At a later conference the Ministry of Health and the Farmers' Union were also included.

In the words of the official report.* "It was found that there was general agreement as to the need for better co-ordination of effort both nationally and locally, and certain suggestions which were put forward were unanimously agreed to in principle." It was decided that these should be embodied in a memorandum, and the National Council was asked by the conference to refer the draft to all the bodies represented and to others likely to be interested in order that it might be more fully considered after their views had been ascertained. A second conference was called in April, 1922, when the memorandum was discussed in detail. The following principles were unanmiously accepted, and these form the basis of the whole government:—

1. The essence of the country problem is to find means to enable country men and women to help themselves, and to bring together all classes in co-operation for the common good.

2. It is essential to encourage the spirit of initiative and co-operation in the village itself, so that the village may formulate its own wishes and face its own responsibilities.

3. No village organisation, however good, is likely to be sufficient for the end in view if it is self-contained. One of the drawbacks to village life is its isolation, and if the villages are to take their rightful place in national life this isolation must be broken down. Educational, recreational, and similar movements in villages cannot be sustained for any length of time without the help given by some form of county and national organisation.

It was decided in the first place to concentrate on county organisation, though from the outset it was realised that a link between county and county was essential, and the National Council of Social Service was asked to act as the co-ordinating centre of the whole movement. Village organisation was also discussed, but it was felt that while the village was the core of the problem, the county was the natural point of departure.

* National Council of Social Service, Memorandum No 19.

The Carnegie United Kingdom Trust and the Horace Plunkett Foundation had given generous grants to enable Oxfordshire to experiment along the lines indicated; as a result of the conference the Carnegie trustees, acting on the advice of the National Council of Social Service, undertook to give financial assistance to a limited number of counties to enable further experiments to be made. The movement, however, has outstripped the grants, and at the moment ten counties in England and one county in Scotland have rural community councils at work, of which eight are in receipt of grants. Not the least interesting point with regard to these councils is the wide divergencies which they show in method and in the type of work done. Nottinghamshire, Derbyshire, and Leicestershire, in addition to having their own individual councils, are also combined in a central council for the whole area, which has its office at University College, Nottingham, and on which are represented not only the county and voluntary authorities, but also the Universities of Sheffield and Manchester. The first Annual Report of the Nottinghamshire Council (published 31st March, 1925) speaks of steady progress:—

> Through the Council meetings close contact has been established between the voluntary county bodies and the Nottinghamshire County Council and their Education Committee. This has been invaluable in getting to grips with the needs of the villages and in obtaining a clear understanding of some of the difficulties of village work. The co-operation between official and voluntary bodies that has resulted from the establishment of the Council has made possible the creation of special facilities for the development of non-vocational adult education in the rural areas of the county. Nearly forty villages have already profited by these facilities.

Kent has made an exceedingly interesting and valuable survey of rural industries in the county, and called a conference of village blacksmiths, which not only attracted considerable attention, but seems likely to have practical results in helping to revive an industry which formerly employed some of the ablest and most capable men in the village. At present motor tractors must be sent away for even minor repairs, with the inevitable delay that this implies and the consequent bill—" as long as a wet week," as one farmer put it. Village smiths, equipped with modern appliances and acquainted with modern machinery might do much of the work at present sent back to the factory: already they have shown themselves capable of producing simple and effective ornamental iron work.

Kent Rural Community Council has also circulated an interesting suggestion as to a new class for village shows: competitions for lads based on the skilled jobs which are done in the ordinary

course of farm work, such as brushing grass with hook and sharpening hook; calculating weight of artificial manure to sow a given square at the rate of —— cwt. per acre; pacing out a given area and marking it; penning sheep without a dog; driving two horses in waggon between posts, backing and turning. It seemed worth quoting this in detail, as it suggests a new way of interesting boys in life on the land and bringing home to them the fact that agriculture is a highly skilled trade which any man may be proud to follow. In this connection it may be noted that other rural community councils are looking into the question of "young farmers' clubs."

Cambridgeshire is interesting itself in the provision of village halls, and the Director of Education, who from the first has taken a most active part in promoting the formation of the rural community council, has produced a most interesting memorandum on the possibility of the "village college" as a centre of social and educational life.

Gloucestershire is specially concerning itself with juvenile welfare and men's clubs.

Oxfordshire, having devoted four years to building a foundation for adult education in the villages, is now turning its attention to questions of public health.

West Sussex, Hertfordshire, and Hampshire are all working on their own lines.

New as the movement is, certain points are already established. In the first place, it is clear that no movement for improved methods of agriculture, no cry of back to the land, will have any effect until we have a race of agricultural labourers sufficiently educated to be able to adapt themslves to new methods, and a village life capable of satisfying the legitimate needs of an intelligent population. Sir Horace Plunkett's well-known formula, "Better farming, better business, better living," is as true to-day as when he first made it the basis of the Irish co-operative movement. In the second place, it is possible to develop in country people that spirit of initiative and self-help without which all effort to improve country life is bound to fail. Nothing is more striking in the Rural Community Movement than the fact that in several cases the immediate result of a council's formation has been the conversion of the county council to the Carnegie Rural Libraries Scheme. Not only is this good in itself, but it has proved an object-lesson in local government which is not being lost. It is one thing to call a public meeting to protest against the rates, or to denounce the closing of a small

school. It is quite another to invite members of the county finance or county education committee to discuss with representatives of men's clubs or women's institutes exactly what certain proposals involve, altogether apart from the heat and stress of controversy. It is becoming not uncommon for a county official to be invited to attend a meeting of village men or women in order that he may tell them what is proposed with regard to health or education, and the mere fact that this is an ordinary club or institute meeting, not one specially called for the purpose, is of importance.

Moreover, the fact that through county organisation village is linked to village is giving a new vitality and a new stability to the work. The small isolated hamlet knows that it has behind it the strength of a county organisation. Village A joins with village B in organising a *fête*. The play that was so successful at X goes the round of the immediate neighbourhood. A new community sense is born, a neighbourliness which extends beyond the parish, and a consciousness of the power which springs from co-operation. One of the greatest difficulties in the past has been that of transport. To get a lecturer or a concert party out to a village is expensive, and even in these days of motor omnibuses there is often no means at all of getting them back again after lecture or performance. Several community councils have spent part of their initial grant on a community car. Oxfordshire is the proud possessor of two, a van and a car, which between them have run some 12,000 miles over country roads during the last six months. Villages pay a mileage rate, and not infrequently two or more organisations share the cost, one speaker being dropped at village A and another taken on to village B.

The problem of social and educational life in the village will, however, never be met by complete reliance upon outside help, any more than by complete restriction to the limited resources of the village itself. It is necessary that the village should both help itself and also take advantage of means of supplementing such provision as it can make within its own boundaries. It is surprising how much local talent is at present hidden under napkins. People do not realise that a simple explanation of their own hobbies is often interesting to their neighbours—that the mere description of a common process can be well worth while. Women's institutes, with their monthly talks and their roll calls, are doing much to show how rich a field lies here untilled. It is not insignificant that at a Federation Council meeting in one

county three delegates in succession from different villages in answer to the que... ...mbers enjoy most last year?" r... ...when the lecturer failed." No slur was intended on any of their lecturers, but, thrown on their own resources the villagers had risen to the occasion and had provided their own mental food. On one such occasion the wife of the village blacksmith held her audience for nearly half an hour while she spoke of the work of the forge; on another the baker's wife spoke on breadmaking; in other instances the meeting has adjourned bodily to some local spot of historic interest and has been told something of British camp or Roundhead siege. But these resources within the village are often unknown and therefore untapped, and the best use can never be made of them until the same principle as that embodied in the rural community council finds expression in the village. Side by side with the county movement is developing the village social council. Here, again, an ounce of experience is worth a pound of theory. At —— a men's club had been in existence for some years and showed a yearly deficit of round about £100. A meeting of the whole village was called, and it was suggested that if all the organisations in the place pulled together and kept in close touch with each other, it should be possible to provide what was wanted with the minimum of expenditure of time and money and the maximum of utility. The result of this meeting was the formation of a village social council consisting of representatives of the men's club, the women's institute, the British Legion, the Mothers' Union, the Infant Welfare Association, the Allotment Holders' Association, the Cricket Club, the Football Club, the Girl Guides, the Song Club, the Slate Club, the School Managers, the Parochial Church Council. This council is recognised in the village as serving the whole community; it provides lectures, concerts, dramatic performances; it controls the village hall, and the deficit on the running of the hall under the old system has been turned into a profit. Overlapping and friction have been done away with. Each society retains its own independence; those affiliated to a county organisation find no change in their relationship to the parent body, but fixtures are arranged in consultation, lectures are made known to every organisation in the village; the village hall is held in trust for the whole community, and is not the property of any one body.

Similar councils exist in other villages, and more than one feud has been healed by their creation. The mere fact of being

able to meet on equal terms representatives of other bodies in the [illegible] and to talk over [illegible] to become grievances, is [illegible] not been able to settle its own difficulties an appeal to the rural community council [illegible] are represented) has sometimes been successful. One rural community council reports:—

> At —— differences between the parish council and the local sports club had held up the provision of a recreation ground for over two years. After a representative of the rural community council had attended one or two meetings in the village the whole matter was settled. The mere fact of an outside impartial body interesting itself in local affairs had a happy effect.

The same principle runs throughout: get together the people who want things, the people whose duty it is to provide at least some of them, and the people who make it their business to provide others. Look at village life, not from the point of view of church or chapel, Conservative or I.L.P., farmer or labourer, but as a whole. Get into the habit of thinking and working in terms of the community without thereby losing one jot of your keenness for your individual organisation. There are those who say that this is a counsel of perfection—who maintain that no labourer wants anything beyond the simplest animal comforts, tempered perhaps by an occasional whist drive or concert of inferior comic songs. It is true that if the county council puts up a list of evening classes or a lecture is announced baldly on education, the audience is likely to be scanty. It is also true that in the purely agricultural county of Oxfordshire—a county with a long tradition of low wages, with all that that implies—during last winter twenty-five regular courses of lectures on humane subjects were given, with an average attendance varying from ten to over thirty: and considering that attendance frequently means a walk of one to two miles or more on a wet winter's night after a day's work, and that some of the centres have a population of under 300, this speaks volumes. The subjects ranged from European history to the romance of exploration; from English literature to how England is governed; and the audiences contained men and women from every class in the village, from the vicar to the charwoman, from the squire to the smith. Moreover, Oxfordshire—which had more than once refused to adopt the Public Libraries Act—has now no fewer than eighty-eight rural libraries under the county council. Other counties have similar experiences, and the importance of these facts lies not so much in the actual value of the subjects

taught—real though this is—as in the growth which they imply. The village and the county are beginning to realise their possibilities and their responsibilities and to desire to face them. In that realisation lies the hope for that fuller and richer life which we all desire. Folk dancing and dramatic tours, concerts and travelling cinemas are all excellent in their way, but we can pour them into villages by the dozen without producing any permanent effect. But once get people to formulate their own demands and themselves to tackle the problem of how to meet them, once get them to take their place whether in local government or voluntary organisation, and future developments can safely be left in their hands.

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THE SETTING UP AND WORKING OF THE RIVER CALE DRAINAGE BOARD.

T. R. FERRIS, M.Sc., N.D.D.,
Director of Agriculture, Dorset County Council.

IN 1921 the County Agricultural Committee for Dorset was informed that the condition of that part of the River Cale in Dorset was very bad owing to the failure of the riparian owners to clean out obstructions regularly, such as beds of silted mud, fallen trees, and also to neglect in the matter of cutting and clearing of river weeds. It was pointed out that those parts of the Cale and its tributaries which lay within the borders of Somerset were dealt with by the Somerset Commission of Sewers; and that the condition of the river in Somerset was much better than it was in Dorset, but that the full value of the work done in Somerset could not be obtained owing to the fact that the bad condition of the river in Dorset prevented flood-water getting away from the Somerset portion of the river system.

The Committee, after inspecting the Dorset part of the river, found that the indictment was fully justified, and that because of the various obstructions it was not uncommon for flood-water to remain out on lands beside the river for periods of several weeks, causing deterioration of the land and in places, also, very seriously affecting the use of roads in the vicinity as well as adding to the cost of their upkeep. The Committee decided that the improvement of the river was an object which deserved any assistance which could be given; and as a first step convened a meeting of the riparian owners and others interested at Five Bridges, which lies on the banks of the river. The meeting was

unanimously of opinion (1) that the condition of the river was bad, and that it was getting worse each year; (2) that, in consequence, the land adjoining was rapidly deteriorating in value; (3) that through flooding for considerable periods the roads near the river were often practically unusable, and the cost of upkeep and repairs were increasing; (4) that, to a considerable extent, the lands adjoining the river in Somerset, near the Dorset border, were also deteriorating owing to the condition of the river in Dorset, the work of the Somerset Commission of Sewers being to some extent nullified thereby; (5) that it was desirable that steps should be taken to put the river in better order; but while owners and occupiers were anxious that the work should be done, and were willing to assist in doing it, none would commence until they were assured that all the others would do likewise.

Formation of the Drainage Board.—After discussion as to ways and means, it was decided by the riparian owners present, (1) that they would each take immediate steps to improve their own portions of the river, and (2) that a petition be sent to the Ministry of Agriculture for a Drainage Board to be formed to deal with the whole river and its tributaries. Following these decisions, the Shaftesbury Rural District Council undertook to find the fee of £20, required to be forwarded to the Ministry of Agriculture with the petition, on the ground that improvements effected to the river would obviate a considerable expenditure on the upkeep of roads under the jurisdiction of that authority.

On receipt of the petition the Ministry took up the matter with the Somerset Commission of Sewers and arrangements were made for the Commission to surrender their jurisdiction over the river in Somerset in favour of the proposed new Board. It was discovered that no maps existed which set out the district under the supervision of the Commission of Sewers, and the County Agricultural Committee therefore arranged for the whole district, drained by the river, to be surveyed in order to define the exact limits of the area which should be subject to the rates of the proposed Drainage Board. When this survey had been completed a conference of the Petitioners and other riparian owners concerned was held, and agreements were reached as to the rating areas and the Ministry drafted and deposited for public inspection the Order and Maps relating to the River Cale Drainage District. The Order was confirmed in January, 1923, and the first meeting of the new Board was held during the following month.

A few words as to the constitution of the Board will probably be of interest. The Order provides that the Board shall consist of 9 elected members who shall each be the proprietors of not less than 10 acres of land, or the occupier of not less than 20 acres of land within the district, together with two appointed members, one appointed by the Somerset and one by the Dorset County Council. In regard to the election of members, the electors are entitled to vote in accordance with the amount of land with which he is concerned within the district on the following scale :—

Area not exceeding 20 acres	... ...	1 vote.
Area over 20 but under 40 acres	...	2 votes.
" " 40 " " 80 "	...	3 "
" " 80 " " 120 "	...	4 "
" " 120 " " 200 "	...	5 "
" " 200 " " 400 "	...	6 "
" " 400 " " 800 "	...	8 "
" " 800 acres		10 "

The period between each election is three years.

It is pleasing to record that after the petition for the formation of a Board had been made in 1921 nearly all the riparian owners took steps to improve their respective reaches of the river, and by the time the Board held their first meeting early in 1923 a large proportion of the stream had been greatly improved and the good effects of the work were beginning to show.

Working of the Board.—To come to the working of the the Board, at the first meetings the matters dealt with were (1) the selection and appointment of Secretary, and (2) the adoption of general principles for future work. In regard to the former, the post—a part-time one—was advertised, and from the applicants a solicitor at Wincanton was appointed at a salary of £50 per annum, this sum to include the use of an office. The general principles adopted were (*a*) That each riparian owner or other person concerned, be himself required to keep his portion of the stream or streams in good order, and that the whole of the streams be inspected by, or on behalf of the Board at definite periods, to see that the work was done in a satisfactory manner; (*b*) That in the case of any portion of the streams not being in proper order and the person concerned failing to carry out the necessary work, an Order be served specifying the work to be done; (*c*) That in view of the foregoing arrangements, rates be levied to cover the administrative expenses only.

The Board has now been working for a period of nearly three years, and it has extended and consolidated the work of clearing the stream commenced by the owners and occupiers in 1921 to the great advantage of the land adjoining. The following facts amply bear this out:—(1) In flood time it was not uncommon for water to overflow and lie stagnant on some of the land for a period of from 3 to 6 weeks at a time; since the stream was cleared it is rare for it to lie about for more than 3 days. (2) Owners and occupiers of land adjoining the stream have stated that some of their land has improved in value to the extent of 10s. per acre. (This may easily be understood in regard to portions of the area, as the outlets of main carrier drains from land adjoining the river were in some cases found to be buried under two feet of silt in the river bed.) (3) Before the stream was cleared it was not an infrequent event during the haymaking season for the crops of some of the land to be ruined by flood-water or washed down stream; no such occurrence has taken place during the past year in spite of the very much larger amount of rain.

The area of land under the Board's jurisdiction is 5,562 acres and the average cost of the working of the Board for the three years it has been in existence, including the preliminary costs of petition, survey of the district, etc., is £105 per annum, or 4½d. per acre.

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THE INTELLIGENCE DEPARTMENT OF THE MINISTRY.

A REPORT has just been published giving in a concise form an account of the Ministry's activities during the three years 1921-24 in the important fields of agricultural education and research, including work in connection with milk and dairy produce, poultry, horticulture, and the improvement of live stock. It continues a similar report for the years 1919-21, which described the policy adopted by the Ministry with regard to agricultural education and research during the years immediately following the close of the War; the present report*

* Report on the Work of the Intelligence Department of the Ministry for the three years 1921-24: H.M. Stationery Office, 163 pp., 5s. net. To be obtained through any bookseller, or directly from the Stationery Office at the following addresses:—Adastral House, Kingsway, London, W.C.2; 28, Abingdon Street, London, S.W.1; York Street, Manchester; 1, St. Andrew's Crescent, Cardiff; or 120, George Street, Edinburgh.

shows the development of that policy during the last three years. The provision of the Corn Repeal Fund of £850,000 has enabled very substantial progress to be made, particularly in the extension and equipment of Research Institutes, University Departments of Agriculture and Agricultural Colleges, and County Farm Institutes.

Organisation.—The general organisation falls roughly into three divisions: (1) research work; (2) the provision of technical advice; and (3) education. The Research Institutes and Stations, 19 in number, are grouped according to the subject of investigation, and are associated (wherever possible) with a University. Advice on farming problems is usually given through the County Agricultural Organiser and his staff, who come into direct contact with the farmer, but (to quote from the report):—

> "They give advice on matters of everyday routine: they are, so to speak, the 'general practitioners' for agricultural ills. But where they cannot diagnose these ills or prescribe the treatment, or where they wish to fortify themselves with the opinion of those who make the class of illness in question their life study, they can call in the specialist officers."

These specialist officers are called Advisory Officers, and are located at "advisory centres" (usually a University Department of Agriculture or an Agricultural College) to which are attached a group of counties forming a "provincial area." The Advisory Officers (chemists, entomologists, mycologists, economists, bacteriologists, and advisers in veterinary science) also form a link between the general body of research workers and the county staffs in their province.

The third division, the teaching of agriculture, falls naturally into two sub-divisions—(1) the higher education provided at University Departments of Agriculture and Agricultural Colleges, usually two- or three-year courses leading to a diploma or degree, and (2) the systems of agricultural education maintained by local authorities. The educational work carried out by the latter covers a wide field, and ranges from courses of one year and under at Farm Institutes (there are now 16 Institutes in operation) down to single lectures on special subjects. The counties also conduct experiments and demonstrations, organise and assist shows, promote clean-milk competitions, furnish advice on rationing, etc., and the majority provide scholarships for courses at Farm Institutes and Colleges. Finally, the whole organisation is co-ordinated:

> "Apart from voluntary organisations, such as the Agricultural Education Association, there is first the unifying influence

of the Ministry which through the power of the purse, can supervise the whole system. Secondly, there is an organisation of Councils or Committees, of which the Research Council (which includes all the Directors of Research Institutes) may be taken as a specimen, or the Animal Diseases Research Committee, or the Committee of Advisory Economists. Thirdly, there are periodical conferences not only of Advisory Officers from all over the country, but also 'Provincial Conferences' between the specialist Advisers at an Advisory Centre and the Organisers of the Counties in the Province served by that Centre. Last, and not least in importance, there is a development of the last two years: a conference of Organisers held at a Research Institute, so that County officers may meet the workers of that Institute and discuss some particular subject of common interest."

Thus the chain is complete. On the one hand, the farmer can command, through the agency of the Agricultural Organiser, next the Advisory Centre, and then if necessary the Research Institutes, the resources of the whole field of agricultural science in helping to solve any particular farming problem with which he may be faced. On the other hand, results of practical importance obtained at a Research Institute are tested out on the experimental and demonstration plots conducted by the college and county staffs, and, subject to any modification suggested by local trials, are brought before the farmer by means of visits, lectures, classes, courses at Agricultural Institutes, publications, etc.:

"It is clear, however, that neither books nor pamphlets nor even lectures will reach the mass of the farming community. The Ministry is bound to repeat that, broadly speaking, the County Agricultural Organisers, with the specialist Advisory Officers as their consultants, must do the main work of instructing and guiding the practical farmer. They are the channel by which the stream of knowledge can most surely and easily flow to its destination."

One further extract from this section of the report may be quoted:—

"The whole organisation described above is young, at least in its present development; before and during the War large parts of it scarcely existed, and other parts were comparatively weak and unsupported. There is still room for much improvement. But it may fairly be said that the main lines of the organisation are firmly traced and the outlines largely filled up; and that the chief requirement now is time for it to settle harmoniously to its work, and to win the closer knowledge and full confidence of the farming community."

Research Institutes.—Each of the three main divisions is described in detail in the report. As stated above, the Research Institutes are grouped according to the subject of investigation. There are thus five Institutes which deal with soils and

crops; five with horticulture; four with animal pathology; three with animal husbandry; one with agricultural economics; and one with agricultural engineering. The work of each Institute is explained in the report: it will be sufficient here to state that during the period under review two important gaps in the system have been filled. The Institute of Agricultural Engineering was established at Oxford in association with the School of Rural Economy, and a new Institute in Animal Pathology was founded at Cambridge. Important extensions and improvements have been carried out at practically all the Institutes, with the aid of capital grants from the Ministry totalling £198,000.

The Advisory Service.—Much interesting information is given in the section dealing with the advisory service, the second of the main divisions. For the purposes of this system, the country has been divided into 14 provinces, each with its Advisory Centre, which, in turn, has its staff of Advisory Officers. Most centres have chemists, entomologists, mycologists, economists and dairy bacteriologists. Veterinary advisers are recent appointments, and are not yet generally established. As regards the duties of Advisory Officers, the chemist gives advice and carries out experiments on soils, manures, feeding stuffs, spraying materials, etc., and in those centres where there is no dairy bacteriologist sometimes also does the bacterial counts in connection with clean milk competitions. The entomologist, who keeps in close touch with the Ministry's pathological laboratory at Harpenden, gives advice and carries out local investigations on plant diseases caused by insects: these officers deal, in the aggregate, with from 3,500 to 4,000 inquiries annually. The mycologist advises on plant diseases caused by fungi and bacteria. The economist provides advice on agricultural economic questions in general, and in particular on questions of book-keeping and accounts, costs of production and farm management. The veterinary officers, besides advising farmers on veterinary problems, carry out local investigations, ascertain the character of the diseases most prevalent in their province and the veterinary matters to which farmers attach most importance. The dairy bacteriologists are, for the most part, employed in carrying out the bacterial counts of milk samples, and as a result of this work advising farmers on methods of clean milk production.

It will thus be seen that the County Agricultural Organiser has, at his call, expert advice on most of the problems which beset the farming community. The grants paid by the Ministry in aid of the work of advisory centres totalled £72,680 during the three years covered by the report.

It is of interest to state at this stage that by means of special research grants investigations are carried out at Research Institutes outside the normal programme of work, or conducted elsewhere than at the Research Institutes. A list of these investigations is given in the report. In order to provide recruits for Research Institutes and Advisory Centres, a small number of research scholarships are awarded annually by the Ministry. A few travelling fellowships are also awarded to existing workers to enable them to familiarise themselves with work abroad.

Education.—Turning now to the important subject of agricultural education, the report records that on the Ministry's grant list there are 15 colleges (9 Agricultural Departments of Universities and 6 Agricultural Colleges) where instruction in higher agricultural education is provided. The annual maintenance grants paid by the Ministry to these colleges amount to £48,500. With the aid of capital grants (usually on a £ for £ basis) from the Ministry, extensive improvements have been made at most of the institutions. The Royal Agricultural College, Cirencester, the oldest college in England and Wales, which was closed during the War, was re-conditioned with the aid of a grant of £15,000 and was re-opened in 1922. The University College of Wales, Aberystwyth, also received a grant of £15,000 in aid of the erection and equipment of new buildings for the Agricultural Department. The Ministry contributed a grant of £7,000 towards the purchase of the freehold of two farms for the School of Agriculture, Cambridge University. Harper Adams Agricultural College, the University of Reading, Seale-Hayne Agricultural College and the Swanley Horticultural College for Women, also received substantial grants in aid of building work. Grants of £15,000 each have been promised in aid of the new buildings which are being erected for the Agricultural Departments of Leeds University and University College of North Wales, Bangor.

With the gradual passing of the post-war conditions the colleges are returning to a normal footing, and the attendance, on the whole, is well maintained. In the spring of 1924 a

census was taken of the future intentions of students who were then attending courses:

> "The figures [illegible] is generally held, that only a small proportion of the students at Agricultural Colleges, etc., intend to become practical farmers. Some 59 per cent. of the students had practical farming as their objective, while another 19 per cent. contemplated posts connected with farming, such as estate management. The proportion of students having official posts in mind was less than was expected, being under 20 per cent."

Considerable progress has been made in the county systems of agricultural education. It would be impossible within the scope of this article to enumerate all the developments—reference must be made to the report itself—but the following summary may give some indication of the work that is being done. Other activities of local authorities in connection with milk and dairy work, small live stock and horticulture, are referred to in the sections of the report dealing with those subjects.

When the previous report was published, 13 Farm Institutes were in being, 7 of which had only just commenced; there are now 16 in operation and another is approaching completion. In addition, considerable improvements have been made to most of the others with the aid of capital grants from the Ministry. During the three years 1921-24, the number of students attending courses at Farm Institutes was 1,989; over 10,000 attended organised day courses; 1,800 attended evening classes and 2,500 received instruction in manual processes. The number of lectures, demonstrations, and other meetings held during the period was upwards of 23,000. The total number of scholarships awarded by county councils for agricultural courses was 2,871, representing a value of over £39,000.

The scholarships scheme for the sons and daughters of agricultural workmen and others was established in 1922. Benefits under this scheme are confined to the children of agricultural workmen, and of other countryside workers in a similar economic position, and to young persons who are themselves bona-fide wage earners in the agricultural industry. The awards range from three or four years at a University Department of Agriculture down to short courses at Farm Institutes, and are of sufficient value to enable the recipients to pass through the courses without cost to their parents. During the three years, 350 scholarships have been awarded,

and an interesting table shows the distribution of the scholarsh[illegible]ng the various [illegible] Another table gives parti[illegible] a number of scholarship-holders who completed courses at Farm Institutes, fr[illegible] is satisfactory to note that the great majority returned to farm work. The report states:

"Consideration of the applications brought to light many cases of people who, by sheer grit and determination, had managed to improve their education though severely handicapped by lack of means; . . . . It is perhaps too early to draw conclusions about the scheme as a whole. From reports on the work and conduct of the scholarship-holders which the Ministry receives from time to time, it is clear that, with exceedingly few exceptions, the scholars are proving themselves capable students, well worthy of the assistance they are receiving, and that some are doing exceptionally well."

Another scholarship scheme initiated by the Ministry during the period provides for the award of scholarships to students who intend to become agricultural organisers, or teachers or lecturers in agriculture. The object of these scholarships, which are for the period of two years, is to broaden the knowledge and experience of the students and to give them an insight into the economic position of agriculture, both at home and abroad. The first awards under this scheme were made in 1924.

A short account is given of the schemes for the training of ex-service officers and men in agriculture. With the exception of the training of disabled ex-officers under the Royal Pensions Warrant, these schemes have now been closed, and some interesting information is given on the results of training in the case of officers granted scholarships or training grants.

Dairying.—The section dealing with milk and dairy work should prove of much interest to all who are concerned with this important subject. Attention is paid to milk production on the farm, the disposal of milk, co-operative cheese schools, and the commercial possibilities of lactose from whey. A short account is also given of the instruction in dairying provided by local authorities. On the subject of clean milk production, it is stated:—

"To a considerable extent the Ministry has concentrated its energies on this subject during the past three years, and it is satisfactory to be able to record a noteworthy improvement in the conditions of milk production throughout the country. The expert advisers on the staffs of Local Education Authorities and Agricultural Colleges are able to help in this movement to a very important degree, and their efforts have been supported by agri-

cultural societies and other bodies, who have devoted much attention to the question of methods of milk production at their annual shows and in other directions. Nor must it be forgotten that milk dealers themselves are now, for the most part, keenly alive to the necessity for securing increased cleanliness in milk, in the interests not only of the general public, but of the trade itself. In fact, this general awakening on the part of commercial interests may well prove to have an influence as great as that of the educational efforts of local bodies. If the trade could see its way to buy milk on the basis of cleanliness, it would go far to solve the problem of clean milk production."

Small Live Stock.—The portion of the report devoted to small live stock deals mainly with poultry. The general machinery for the provision of instruction in this subject along modern lines is explained, and an account is given of the National Poultry Institute Scheme, towards the cost of which the poultry industry, consisting mainly of " small men " with comparatively little capital, has contributed over £6,000. Two further schemes for the improvement of poultry stock are described, namely, the Egg and Chick Distribution Scheme and the County Egg Laying Trials, both carried out under the auspices of the local authorities.

Horticulture.—In the horticulture section, the work of local authorities with regard to horticultural education is explained, and as a concrete example a description is given of the work carried out by the staff of one authority. Much valuable information is also given on the subject of potato demonstration trials, bee-keeping, the standardisation of fruit packages, the grading and packing of fruit and vegetables, and the testing of new varieties of fruit trees. The action taken by the Ministry under the Destructive Insects and Pests Acts is reviewed, and the working of the various Orders, with special reference to those made for the control of wart disease of potatoes, is described.

Live Stock Improvement.—The report next records the satisfactory progress that has been made in the Live Stock Improvement Scheme. The advance is most marked in milk recording, the number of cows recorded increasing from 97,903 in 1920-21 to 138,086 in 1923-24, notwithstanding the hampering restrictions during this period consequent on the serious outbreaks of foot-and-mouth disease. The demand for premium bulls and boars has also steadily grown. The grants for heavy horses which were withdrawn for reasons of national economy after the year 1921-22 have been revived during 1924-25. A decrease has been recorded each year in the number of

stallions licensed under the Horse Breeding Act, 1918. There is reason to believe that as a result of the working of this Act unsound stallions which formerly travelled at low fees have practically been eliminated from the road.

The report concludes with a short note on the National Stud, the operations of which continue to be satisfactory, the accumulated trading profit being £30,050. In 1922, the National Stud headed the list of Winning Breeders with 25 horses winning 42 races of the total value of £32,939.

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THE SEEDS ACT, SEASON 1924-25.

IN connection with the administration of the Seeds Act, the modification of the intensive inspection of seedsmen's premises, commenced during the 1923-4 season, was further developed during the past season. Visits of Inspectors of the Ministry during the 1924-5 season were confined, to a large extent, to those made for the purpose of drawing control samples of the seeds offered for sale. Purely advisory visits were paid only where circumstances indicated that these were necessary. The latter included a number of establishments dealing in seeds as a "side-line" and which had not been previously discovered by the Inspectors. In this way the total number of visits paid by Inspectors, which was 9,000 in 1922-3, was reduced to 4,500 during the 1924-5 season, with the addition of about 1,000 to establishments which had not been visited previously. The Act has been in operation since 1921 and it is believed that the majority of seedsmen are now quite familiar with its terms and that they are carrying out its requirements to the best of their ability. The intensive inspection which was conducted when the Act first came into operation is therefore no longer necessary.

Control Sampling.—The reduction in the number of purely advisory visits has made it possible to pay greater attention to the drawing of control samples. During the season, some 1,418 such samples were taken as compared with 613 in the previous season. The main purpose of drawing these samples is to ascertain, by check tests at the Official Seed Testing Station, whether the particulars as to germination, purity, etc., which are given by the seller, are accurate. The samples taken during 1924-5 included 253 samples of clovers, 172 of grasses, 101 of field and root seeds, 420 of vegetable seeds (apart from

seeds sold in packets) and 39 of cereal seeds. The check tests showed that in 110 of these 1,418 samples the declaration made by the seller was incorrect in some material particular. These included 17 samples of grass seed, 42 of clover, 4 of field, 3 of root, 19 of garden and 2 of cereal seeds. In 30 cases the germination differed by from 10 to 15 per cent., 13 differed by from 15 to 20 per cent., and in 20 cases the germination figure was more than 20 per cent. out. The purity figure was wrong to the extent of from 3 to 5 per cent. in 10 cases, from 5 to 10 per cent. in 4 cases and over 10 per cent. in 6 cases. In the other cases the principal source of error was the omission to declare the presence of dodder or of injurious weed seeds. Taken as a percentage of the total number of samples drawn, the serious discrepancy cases amounted to 7.7 per cent. as compared with 9 per cent. in 1923-4 and 11.5 per cent. in 1922-3. This indicates a slow but steady improvement.

Packet Seed.—Further improvement in the quality of seeds sold in packets is shown by the fact that, of the 432 control samples taken, 94 per cent. were found to be above the minimum standards laid down in the Regulations. The corresponding figure for the previous season was 90.6 per cent. Of the packets falling below the minima, 1.6 per cent. were above two-thirds of the standard, and 4.4 per cent. were below two-thirds of the standard. The Seeds Act has had a marked effect on the quality of seeds sold in packets. Large quantities of very inferior seed used to be disposed of in this manner, but the above figures indicate that while there is still room for further improvement the position is much more satisfactory than it was before the Act came into operation.

Farmer to Farmer Sales.—Considerable attention has been given to this matter during the season. Visits have been paid to nearly 1,000 farmers who were believed to be offering seeds for sale. As a result of these visits and of the educational campaign which has been followed by displaying special seed exhibits at agricultural shows, lectures to meetings of farmers, paragraphs in the Press and in farming publications, there are indications that the farmer seller is coming into line with the seedsman as regards the supply of the necessary particulars when selling his seed. This improvement is considerably assisted by the fact that purchasers of seed are realising more than ever the value of knowing the quality of their seed, and it is hoped that in course of time no

farmer will be satisfied unless he receives these particulars, to which he has a statutory right, even when buying seed from a neighbouring farmer.

Licensed Private Seed Testing Stations.—The number of private stations in England and Wales, licensed by the Ministry to test seeds for the purpose of the Act has been increased by one during the twelve months under review. These stations now include 31 to test all kinds of seeds covered by the Act, 3 to test all seeds other than grasses, 6 to test field and cereal seeds, 5 to test field seeds, 35 to test cereal seeds and 7 to test cereals and certain other selected seeds. For the purpose of checking the results obtained at the licensed stations, 1,117 special samples were taken by the Ministry during 1924-5 as compared with 779 in the previous season. The results of the check tests on these samples were communicated to the stations, and all cases of serious discrepancy were followed up by correspondence or by personal discussion with the analyst concerned.

Referee Samples.—As a further means of checking the work carried out at the licensed stations a further series of "Referee Samples" was issued to them during the season. These samples were drawn from uniform bulks of white clover, cocksfoot, perennial ryegrass, tares, mangold and onion seed. The results of the tests obtained at the various stations could therefore be compared with those obtained on similar samples at the Official Seed Testing Station. Of the six sets of samples distributed the results obtained with the onion seed were the most satisfactory, as, although it was a difficult sample, all the stations obtained figures which were within the limits of variation of those of the Official Seed Testing Station. The perennial ryegrass and the white clover samples were also well done, though some of the examinations of the latter sample for dodder were not very satisfactory. The germination tests of the mangold and tare samples and both the purity and germination tests of the cocksfoot sample showed rather a wide variation, but this is partially explained by the fact that the samples were probably more difficult than those usually handled at the licensed stations. On the whole the results of these check tests indicate a satisfactory progress towards uniformity on the part of all the stations.

Training and Examination of Seed Analysts.—The fourth annual course of training for seed analysts was held during the summer at the Official Seed Testing Station. Fourteen analysts

attended and displayed great interest and keenness in the work. At the end of the course 20 candidates sat for an examination, of whom 13 passed.

Seed Analysts' Conference.—The Third Annual Conference of Seed Analysts was held at the National Institute of Agricultural Botany on the 7th August, and was attended by a large and representative gathering of analysts. The conference devoted itself mainly to a close examination of the results of the tests on the "Referee Samples" referred to above and to a consideration of those methods of treating and testing seed which secure the most uniform results.

During the afternoon members of the newly-formed British Association of Commercial Seed Analysts held a meeting at which it was decided, inter alia, that certain members should each undertake investigational work in the testing of specified groups of agricultural plants.

"Seed Analysts Bulletin."—In order to further one of the principal aims of the Official Seed Testing Station, which is to develop the closest possible co-operation between the various licensed stations and the official station, the Ministry has arranged to issue from time to time to licensed stations a Bulletin of information with regard to investigational work in seed testing and any other matters which may be of interest to seed analysts. Five numbers of this Bulletin have been issued to date, and it is proving a very convenient means of bringing seed testing information to the notice of seed analysts throughout the country.

Fourth International Seed Testing Congress.—Copies of the Report of the Fourth International Seed Testing Congress, which was held at Cambridge at the invitation of the British Government in July, 1924, may now be obtained through any bookseller or directly from His Majesty's Stationery Office, Adastral House, Kingsway, London, W.C.2, price 11s. 6d. each (postage inland 3d. or foreign 4d. per copy extra). This Congress was attended by official representatives of no less than twenty-six countries, and included the Directors of all the principal seed testing stations in the world. A number of technical papers dealing with various aspects of seed testing were read and discussed. The keynote of the work of the Congress was "efficiency and uniformity" both in the practice and the methods of seed testing and also in the form in which the results of tests should be issued in order to give the maximum amount of information to the dealer and to the user of seeds.

The Report now issued should be of the greatest interest and use to anyone engaged in the testing of seeds or interested in the technical side of the seed trade. It includes full copies of all the papers that were read and an account of the discussion which followed in each case. A summary of the proceedings is also given in French and German.

Important Judgments with Reference to the Seeds Act.—An important judgment with reference to the Seeds Act was delivered at Peterborough on the 31st March in a case in which a farmer was sued for the price of some Maple peas, and in which he set up the defence that the plaintiff having failed to deliver a statement in writing containing the prescribed particulars as to variety, percentage of germination, purity, etc., as required under the Seeds Act, the contract for the sale and purchase of the seed was illegal, and therefore unenforceable. Judge Farrant decided that this defence was a sound one, and delivered judgment for the defendant with costs.

Another case, heard at the Leeds Assizes, turned on Section 6 of the Seeds Act which lays down that, for the purpose of any legal proceedings on a contract for the sale of seeds, the particulars delivered in compliance with the Act shall be deemed to be true unless they are shown to be untrue on a test made at an official seed testing station of a sample taken by the purchaser within ten days of the date of the delivery of the seed. In the case in question a farmer sued a seed merchant for breach of warranty in connection with a quantity of seed peas which the merchant sold with a declaration that the germination was 70 per cent., but which had failed to produce a crop. The farmer's claim failed on the grounds that he had not taken steps to obtain an independent test and that the statement delivered by the merchant must therefore be deemed to be true. (Finney *v.* Mell, Yorkshire Assizes, Leeds, 12/5/25.)

Seed Potatoes.—A considerable amount of work was carried out during the season in connection with the requirements of the Seeds Act in the case of a sale of seed potatoes. The Act requires in these cases that the seller shall make a statement in writing as to the class (which is in effect the country of origin), the variety (which must be true of 97 per cent. of the quantity sold), and the size and dressing (in other words the size of the top and bottom riddles through and over which the potatoes are dressed). It is an easy matter to check the

statement as to size and dressing, but owing to the difficulty of identifying with certainty the variety of potatoes when in the tuber stage it is necessary in all cases of doubt as to the variety of the seed for a sample to be grown on at the Ormskirk Potato Testing Station. During the season numerous tests were carried out by Inspectors as to the size and dressing statement, and a number of samples were taken for the statement as to variety to be checked by growing on. Numerous inquiries are necessary also in cases where the accuracy of the statement as to variety given with the seed is not doubted until the crop is grown. Some of these cases are reported by the growers themselves, but the majority are those discovered by the Inspectors when examining crops for the issue of purity certificates under the Ministry's crop inspection scheme. In all cases where, as a result of careful inquiry, it seems clear that the statement as to the variety of the seed supplied was inaccurate, the matter is taken up with the supplier, and, in suitable cases, proceedings are taken for a breach of the Seeds Act. All cases in which the seed is supplied from Scotland are reported to the Board of Agriculture for Scotland, which is the Department responsible for the administration of the Seeds Act in Scotland.

Sale of Seeds by Auction.—Considerable difficulty has been experienced in securing that the requirements of the Act, as to the delivery of the specified particulars in the case of a sale, are complied with when seed is sold by auction, particularly where seed potatoes are concerned. Inspectors have called on a large number of auctioneers who conduct this class of sale, in order to draw their attention to the Regulations, and a quantity of posters stating briefly the requirements of the Regulations in the case of a sale of seed potatoes by auction have been distributed for display on market boards and other suitable places. The Auctioneers' and Estate Agents' Institute has also been very helpful in bringing the Regulations to the notice of its members.

In order to test the position of the auctioneer in these cases, proceedings were taken by the Ministry against a north-country auctioneer who sold potatoes merely as "potatoes," but which were clearly intended for planting. The Justices found that an offence had been committed both by the auctioneer and by the person who had instructed the auctioneer to sell, and inflicted a fine on both parties with costs.

Seeds (Amendment) Act, 1925.—Proceedings for an offence against the Seeds Act, 1920, must normally be instituted within 6 months of the date of the alleged offence. It has, however, frequently been found in practice that it is impossible to ascertain whether a consignment of seed potatoes has been correctly described as regards variety until the crop is grown, which may often be more than 6 months after the date of the delivery of the seed. An amending Act—the Seeds (Amendment) Act, 1925—has now been passed which permits of proceedings for an offence under the Seeds Act, 1920, for making or causing to be made a false statement as to the class or variety of seed potatoes, being commenced at any time within 12 months of the date on which the alleged offence was committed. The amending Act does not affect in any way sales of other kinds of seeds covered by the Seeds Act, 1920.

Prosecutions.—The following are brief particulars of the cases in which the Ministry has instituted legal proceedings under the Act during the past season:—

1. A charge was heard at Stourbridge on 24th April, against a local firm for failure to display and deliver the required particulars with seed potatoes. The defendants pleaded guilty, but suggested that they had some difficulty in understanding the requirements of the Act. The case was dismissed on payment of costs and the solicitors' fees.

2. At Bath on 1st May, a local firm was prosecuted for failing to deliver the necessary particulars in respect of a sale of seed potatoes. The defendant in this case was visited and informed of the provisions of the Act some week or two previous to the purchase of the sample in respect of which proceedings were taken. A conviction was obtained and a fine of £1 imposed.

3. On 30th June, a case was heard at Maidstone against a local firm for failing to deliver the necessary particulars correctly in the case of a sale of Wild White Clover seed, and a fine of 10s. was imposed. This prosecution was instituted as the result of information supplied by the Board of Agriculture for Scotland.

4. Proceedings were instituted on 28th July against a firm of auctioneers at Penrith, who sold potatoes as such, but which were clearly intended for use for planting and with which no statutory declaration was made. The Justices found that an offence had been committed both by the auctioneers and by the person who had instructed them to

sell, but as the charges were the first of the kind in the district, they fined the defendants only £1 each and costs.

5. A Margate firm was summoned on 29th July for (1) failing to display the necessary particulars in the case of seed potatoes exposed for sale; (2) failing to deliver these particulars in the case of a sale; and (3) failing to quote the certificate number issued under the Wart Disease of Potatoes Order. The defendant was fined £2 for each offence, and directed to pay 1 guinea costs—a total of £7 1s.

6. A corn merchant at Pontypool was summoned on 4th July, for failing to deliver to a purchaser the necessary particulars in the case of a sale of Trefoil seed, and for exposing the seed for sale without displaying the required statement. The Bench decided that in the first case defendant should pay 40s. costs, and that the second case should be dismissed.

7. On 23rd July, a firm at St. Albans was fined £2 and 2 guineas costs for selling onion seed with a declaration that the germination was not less than the prescribed minimum, viz., 60 per cent. The seed was shown by test on a control sample to germinate only 33 per cent.

Amendments of Seeds Regulations.—No amendments have been made in the "Seeds Regulations, 1922," so that, unless some unforeseen circumstances should arise, the Regulations will be the same during the 1925-6 season as those which were in operation last season.

NOTE.—Copies of the Seeds Act, 1920 (price 3d. net), the Seeds (Amendment) Act, 1925 (price 1d. net), and the Seeds Regulations, 1922 (price 3d. net), may be obtained through any bookseller, or direct from His Majesty's Stationery Office, Adastral House, Kingsway, W.C.2.

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ENSILAGE.—VIII: THE FUTURE OF SILAGE.

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PREVIOUS articles in this *Journal* between November, 1924, and May, 1925, have dealt with different aspects of ensilage as practised in this country. There remains this concluding article to define the possibilities for the future. During early years in the development of any agricultural practice which is new to a country, investigators are properly cautious and content to

study, and try to solve the problems which arise in their own experience or in that of the more enterprising farmers who "take a chance" with the new practice. When evidence and experience have been collected and when the initial difficulties have been overcome, it is conceivably the duty of the investigator either to advocate or to condemn the practice which is under investigation. The American type of tall tower silo, whether of wood or concrete, has now been in use in this country for more than 10 years. Experimental evidences of suitable crops, methods of making, and food values have been collected by many observers; and some of the initial difficulties have been overcome and numerous costs of production are available. With these facts in front of me, and with a careful personal study of the practice, I am prepared to say that I believe there is a large future for silage in this country in those arable districts where for one reason or another root crops cannot be economically grown.

Suitable Crops.—It has been shown by Cruickshank at Aberdeen that mixtures containing a large proportion of beans with oats and a light seeding of tares and peas produce very heavy yields of fodder suitable for silage on clay land. Drew at Glasnevin and Rae at the Hertfordshire Institute have shown the same. At the University farm at Cambridge in 1925 a mixed crop seeded with 180 lb. of beans and 15 lb. of tares produced a crop varying between 12 tons and 15½ tons of green weight per acre, equivalent to between 2½ and 3⅓ tons of dry crop and to between 7½ and 10 tons of standard silage containing 30 per cent. dry food materials after allowing for a loss of 10 per cent. due to fermentation in the silo.

On light land mixtures of oats and tares, provided the seeding of tares does not exceed 60 lb. per acre on good land and 90 lb. on poor land, yield good crops and can be cheaply grown and conveniently made into silage.

For the warmer districts, suitable varieties of maize are being found which mature sufficiently for silage and yield heavy crops. Thus at Cambridge in 1925 the following yields were obtained on quarter-acre plots on a poor gravel soil with early-maturing varieties.

TABLE I.

	Green Crop. Tons per acre.	*Dry Crop. Tons per acre.*
Salzers North Dakota	25.7	3.4
Longfellow	17.0	2.9
Wisconsin	18.0	3.2

A French variety named Jaune Gros, grown for the first time in England gave even better promise. It produced on a small plot a yield of 15 tons green crop and 3.1 tons dry crop per acre. In this case almost every plant produced two large cobs which when cut on 21st September were passing into the glazed state which American experience considers ideal for silage. It may, therefore, be stated that crops suitable for yield per acre, for easy harvesting and for making into good silage can be grown in this country with certainty.

Evidence of Food Value.—Drew* at Glasnevin has shown that silage made from a mixture of beans, oats and tares grown on heavy land may be compared with roots, whether fed to milking cows, store cattle or fattening cattle, on the basis that 6 lb. of silage, containing about 25 per cent. of dry food material and 75 per cent. of moisture, are equivalent in feeding value to 10 lb. of roots together with some hay. In the majority of the experiments described, hay was fed *ad lib.* to both lots of cattle and an account was kept of the weights consumed. On the average it worked out that about $\frac{1}{3}$ lb. more hay was eaten by the root-fed cattle than by the silage-fed cattle for each 10 lb. of roots consumed. We thus get the equation—

6 lb. of 25 per cent. silage = 10 lb. roots + $\frac{1}{3}$ lb. hay.

If we assume 1 lb. hay = 3 lb. silage; then it follows after cancelling on both sides of the equation that

5 lb. of 25 per cent. silage = 10 lb. roots.

Drew has also shown that store cattle, fed on silage through the winter, thrive better when turned out to grass in summer than do root-fed cattle.

Sheehy and Delaney† at Athenry, at the conclusion of a number of feeding experiments in 1922-23 and 1923-24 with milk cows, fattening bullocks and rearing calves, after stating, quite rightly, that the success of the silage system depends primarily on the quality of the cured silage, continue by saying that in the light of their experiments $5\frac{1}{2}$ lb. of silage is a safe figure to adopt as the weight of silage of equivalent food value to 10 lb. of mangolds. Incidentally it may be

* Jour. Dep. of Agric., Ireland, Vol. XXIII, No. 2, and Vol. XXIV, No. 3.

† Jour. Dep. of Agric., Ireland, Vol. XXIV, No. 2.

stated that a good deal is now known of the conditions which ensure the making of good quality silage.

Neither Drew nor Sheehy and Delaney state definitely in their conclusions the percentage of dry food material in the silage, but from the context and the nature of the climate it is probable that this approximates to 25 per cent.

Rae and Gardner* conclude as a result of feeding silage against roots to dairy cows that 1 lb. of good silage (containing 25.4 per cent. dry food material) = 2 lb. roots.

Robertson and Pitcher† showed that when comparing silage made from beans, oats and tares with roots on the following rations:—

SILAGE RATION.		ROOT RATION.	
Silage	50 lb.	Mangolds	50 lb.
Hay	10 "	Hay	10 "
Dried Grains	4 "	Dried Grains	4 "
Concentrates	3 "	Concentrates	5 "
		Oat Straw Chaff ...	18 "

that approximately equal quantities of milk were produced by both lots of cows. By cancelling the foods common to both rations we find that:—

50 lb. of silage, containing 30 per cent. of dry food material, was equivalent to 50 lb. of mangolds, 18 lb. oat straw chaff and 2 lb. of concentrates consisting of decorticated cotton cake and bean meal.

Woodman‡ in comparing the digestibility of the same crop of oats and tares when fed to sheep (i) in the green state, (ii) made into hay, (iii) made into silage, has shown that the productive starch equivalents of 100 lb. of the dry food material of each of the products compare as follows:—

Green crop	44.92
Crop made into hay	43.24
Crop made into silage	45.59

and calculated as metabolisable energy per 100 lb. of dry food material:—

Green crop	gave 116.23 Therms.
Crop made into hay ...	" 113.10 "
Crop made into silage ...	" 117.23 "

* This *Journal*, October, 1925.
† This *Journal*, September, 1921.
‡ Jour. Agric. Science, Vol. XII, Part II.

In this important experiment it is shown that the dry food material of the crop made into good silage has a higher nutritive value than the same crop made into good hay, and is equal to that of the crop fed green. But even this does not complete the case, for Woodman has shown that these digestion and metabolisable energy figures take no account of the fact that succulent silage can be masticated and digested with less expenditure of energy than can dry hay, so that this balance should rightly be credited to silage. Moreover, it will generally be admitted that a good crop of oats and tares can be more certainly made into good silage than into good hay.

The writer* has shown in feeding experiments during 3 years with a total of 56 yearling cattle fed identical rations (except that one lot received 10 lb. of oat and tare hay, and the other lot oat and tare silage containing an equal quantity of dry food material to that contained in 10 lb. of hay) that the average daily increases were as follows:—

Cattle fed Silage: 1.56 lb. Cattle fed Hay: 1.15 lb.

This means that over a winter feeding period of 6 months silage-fed cattle would increase in weight by 75 lb. more per head than hay-fed cattle, a difference sufficient to result in the silage-fed cattle being fat whilst the hay-fed cattle would be fresh stores or only half-fat. The conclusion may safely be drawn that an oat and tare crop made into silage is worth for feeding considerably more than the same crop made into hay, and serves to confirm in feeding trials what Woodman has proved in a digestibility experiment.

Enough has been written to prove that silage as a food is worth in practice quite as much, if not more than, the chemical analysis would lead us to suppose. Now come the questions what does it cost to produce, can it be grown economically, can it be made to fit into general agricultural practice?

Cost of producing Silage.—A large number of estimates of the cost of producing silage have been compiled and published during the last few years. Table II following gives a selection from reliable authorities:—

* This *Journal*, June, 1925.

TABLE II.—COSTS OF PRODUCTION OF SILAGE.

	AUTHORITY.	Seed Rate in lb. per acre.	Crop per acre as silage.	Per cent. of Dry material in Silage.	Cost per ton.	Cost per ton calculated as "Standard" silage 30% Dry material.
			Tons.		s. d.	s. d.
1	Robertson and Pitcher, 1921 ...	Tares 180, Oats 24, Beans 30	5	29.16	10 0	41 2
2	Hall, Rcsparveth...	Not stated ...	14	not stated	20 10	–
	Denham ...	" " ...	7	" "	30 0	—
	Hucknall ...	" " ...	12	" "	20 8	—
3	Drew, 1922 ...	Beans 140, Peas 42, Tares 42, Oats 84	13	22.52 to 26.02	23 $9\frac{1}{4}$	29 4
	" 1923 ..	Beans 168, Peas 42, Tares 42, Oats 84	11·5	25 ?	26 10	32 2
4	Sheehy and Delaney	Beans 84, Tares 98, Oats 84	6	?	59 6	—
5	Rae and Gardner ...	Tares 96, Beans 64, Oats 42, Wheat 31	11 (Green Crop)	25.4	19 9	23 4
6	Cruickshank (a) Cruden Bay ...	Beans 192, Peas 32, Tares 32, Oats 84	12	25	24 3	29 1
	(b) Radnor	Beans 64, Oats 42, Tares 64, Peas 48, Rye 48	$16\frac{2}{3}$	25	22 9	27 3
7	Gen. Adlercron, Culverthorpe, 1923	Beans 60, Tares 90, Oats 60	$5\frac{1}{4}$	30	27 3	27 3
	" 1924		5	30	33 8	33 8
	" 1925		$6\frac{1}{8}$	30	27 5	27 5

The above table shows very wide variations in the cost of producing silage due in some cases, probably, to the amount of silage being over-estimated. This is especially liable to occur when the crop is weighed green and the assumption made that this represents the weight of silage to be produced. In other cases, where the costs are excessive, as in the case of Robertson and Pitcher, it may be attributed to an unsuitable seed mixture—in this case too many tares resulted in a laid crop at the first attempt to make silage.

The three concluding costs, furnished by Mr. E. H. Davies, who manages for General Adlercron in Lincolnshire, are perhaps of greater significance than others in the table, because they refer to commercial conditions where accurate farming costs are kept; because the crops were grown on ordinary heavy land of average quality; because they refer to three consecutive

years' work; to a total area of 134 acres and a total production of 730 tons of silage; and because the crop is estimated as weight of silage, checked each year by weighings as the silage is consumed. For these reasons the costs of production of the crops have been restated in greater detail in Table III.

TABLE III.—COSTS OF SILAGE CROPS AT CULVERTHORPE, LINCOLNSHIRE.

	1923.			1924.			1925.		
Acreage	35			47			52		
	£	s.	d.	£	s.	d.	£	s.	d.
Costs of growing	98	16	9	145	8	0	171	8	5
Costs of harvesting and filling	56	17	0	93	0	0	108	0	11
Interest and Depreciation, Silo and Cutter : 3s. 6d. per ton	33	5	0	38	10	0	56	0	0
Rent and Rates : 30s. p.a.	52	10	0	70	10	0	78	0	0
Miscellaneous : 10s. p.a.	17	10	0	23	10	0	26	0	0
Total	258	18	9	370	18	0	439	9	4
Silage produced	190 tons			220 tons			320 tons		
Cost per ton	27s. 3d.			33s. 8d.			27s. 6d.		
Average cost per ton over the period of 3 years							29s. 3d.		

The foregoing table gives the detailed costs of producing 190 tons of 30 per cent. silage in 1923 at 27s. 3d. per ton, of 220 tons in 1924 at 33s. 8d., and of 320 tons in 1925 for 27s. 5d.—or an average cost of 29s. 3d. per ton over the whole 730 tons in the 3 years. If this cost had been calculated on silage containing only 25 per cent. of dry food material, the cost per ton would have been 24s. 5d.

No credit in this account is given either to the convenience which accrues to the farm by being able to break up 35 to 50 acres of heavy land in July, give it a "bastard" fallow before harvest and prepare it for early autumn drilling by wheat or other autumn corn, or to the accumulation of fertility to the holding which occurs when the silage is fed and the dung returned, in place of a bare fallow. It is also worthy of comment that these costs have been obtained with moderate crops varying between 5 and 6½ tons of 30 per cent. silage per acre; and that this silage has been and is being fed to a herd of dairy cows from which over 100 gals. of "certified" milk are being marketed daily, indicating that the silage does not taint or otherwise spoil the milk.

Now Drew at Glasnevin and Sheehy and Delaney at Athenry have shown that one pound of good silage containing 25 per cent. dry food material has the equivalent food value of very nearly two pounds of mangolds. Therefore, when silage containing 25 per cent. dry food material can be produced at 24s. 5d. per ton, mangolds must be grown at less than half this cost, say 12s. 3d. per ton, to compete with silage in value; because silage can be fed to stock much more cheaply than roots; because silage fits into heavy land management much more easily than do roots; because the seed bed is much easier to prepare; and because the harvesting takes place in July instead of October-November.

If the comparison of silage be made with hay then our own experiments at Cambridge with 56 yearling cattle over three winter periods have shown, when oat and tare silage was fed against oat and tare hay on the basis of equal weights of dry food, that the average daily increase of silage-fed cattle was 1.56 lb. per day against 1.15 lb. per day with hay-fed cattle. This is equivalent to a difference of 75 lb. of increased live-weight per head over a winter feeding period of 6 months—a difference sufficient to turn an 18-month half-fat bullock into good young beef at the same age.

During the past year some 20 18-month bullocks, fed largely upon silage, have been sold fat from the University farm at Cambridge at prices varying between 12s. 6d. and 13s. 6d. per stone of 14 lb. dead-weight and have realised an average of £28 2s., though they received only 4 lb. of cake and meal except during the last month of feeding when the ration was raised to 6 lb. or 8 lb.

The winter feeding of cattle in America is now very largely based upon silage made from maize, because this is a succulent food capable of being secured and fed at a moderate expenditure for labour. There would appear to be good prospects of extending silage practice in those districts in Britain where, owing to the heaviness of the soil on the one hand or lightness of soil in dry districts on the other, the cost per ton of roots is prohibitive now that certain preliminary difficulties with regard to suitable crops on different soils, methods of making silage and construction of silos have been or are being overcome.

How to extend the Practice of Ensilage.—The foregoing figures and arguments will have shown that there is a real prospect of making ensilage a profitable adjunct to heavy land farming as well as to other districts where roots are unprofit-

able, not only because it can be produced at a reasonable price, fed economically, lends itself to management on "factory" lines and "fits" with other heavy land management; but because, automatically, it leads to an increase in the fertility of the holding upon which it is grown through the extra dung which is made when the silage is fed, for it must be fed on the farm where it is grown.

When this dung is distributed, the organic matter in the fields is increased, tillage is made easier and the cropping capacity automatically increased. This is a basis for improving agricultural prosperity, in place of the modern advocacy of the so-called "law of diminishing returns" which so frequently results in crops being grown at the expense of loss of fertility, accumulation of weeds and depreciation of drainage unless the land be laid down to grass.

These then are the reasons why landowners, who possess land of the description indicated should be willing to erect a silo on the farm of an enterprising tenant who may wish to make use of the silage practice. If the capital is required it can be borrowed from the Lands Improvement Company for the building of a silo with the approval of the Ministry of Agriculture and Fisheries, who charge 4½ per cent. on sums of £500 and over, and 4¾ per cent. under £500; this interest together with repayment of capital in 20 years makes an annual charge of £7 12s. 9d. or £7 16s. per £100 in each case.

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COUNCIL OF AGRICULTURE FOR ENGLAND.

THE 18th Meeting of the Council was held on 27th October at the Middlesex Guildhall, Westminster; Mr. James Donaldson in the Chair.

Grant of £1,000,000 for Empire Marketing.—Arising out of the Minutes of the 16th Meeting, *Lord Strachie* (Somerset) inquired as to the position in respect of the resolution referring the question of the proposed annual grant of £1,000,000 to assist the marketing of Empire produce in this country, to the Committee on Agricultural Policy. The Chairman replied that the matter had not escaped the observation of the Committee, though they had not reported upon it. If, however, any member desired the matter brought before the Council again, it could be done by a reference of it now to the Standing Committee. Lord Strachie asked that the matter might be so referred.

Statement by the Minister of Agriculture.—In the course of his address, *Mr. Wood* referred to the Council's suggestions on Agricultural Policy, and said they were receiving the very careful attention of the Government. The outcome of the Government's deliberations would be announced in the first instance to the House of Commons when it was reassembled. He would, therefore, only deal with matters arising out of previous meetings of the Council and refer to one or two other subjects. First, as to Rural Housing, he said that the Minister of Health had replied to the suggestion which the Council had made that increased assistance should be offered from the Exchequer to those rural district councils which had used their powers under the latest Housing Act to the extent of a penny rate, to the effect that the suggestion would involve legislation and could hardly be justified as a special concession to rural district councils. A differential subsidy had already been provided to enable rural district councils to erect houses in agricultural parishes at no greater rate burden than was applicable to the country generally. and the Minister of Health did not see that a further subsidy on the lines suggested could in practice be limited to rural authorities.

The Minister then outlined the Ministry's new Sheep Scab proposals. He also informed the Council that a Bill was in draft to require the sale of all fat cattle by live-weight. It would, however, not be possible to introduce that Bill this

session. With regard to the question of the compulsory registration of bulls, the Agricultural Advisory Committee had expressed itself in favour of the Ministry's plan, and he would like to have the views of the Council also upon it.

The Minister said he would take the opportunity of saying something on certain of the resolutions down on the agenda, as he had to leave the meeting before they could be taken. As regards licensing of potatoes, a system of the kind could only run counter in spirit if not in letter to the pledges which the Prime Minister had made with regard to the taxing of foodstuffs before the election of the present Parliament. As regards tithe, great numbers of the clergy said that the Bill was unfair to them, while some tithe-payers said that it was also unfair to them. The old basis of redemption, however, in operation before the 1918 Act was redemption at par, even though tithe was at any given time much below par. That basis was generally recognised to be unsatisfactory, and it was for that reason that the 1918 Act deliberately altered it and substituted a fair actuarial equivalent of the estimated perpetuity value of tithe. Proceeding on that basis, the Government had on the best advice obtainable fixed the figure at 105. It was neither legally, politically, or ethically justifiable to upset the 1918 basis because between 1890 and 1910 the value of tithe had fallen below what the framers of the 1836 Act had considered probable. Tithe-payers should not forget two or three positive advantages the Bill afforded. Without a new Act the value of tithe would rise to 130. The accumulation of the sinking fund for redemption purposes under the Bill was to be made by Queen Anne's Bounty instead of by the landowners, and that was more favourable to the tithepayer as such accumulations were not subject to income tax. Lastly, under the Government's present proposals, an Exchequer grant was to be given in relief of the burden that was laid on ratepayers by the 1920 Act.

As regards Mr. Grey's motion on small holdings, the Government was proposing to introduce a Bill later on in the year to carry out what was required under the arrangement for the 1926 Valuation. The main lines of the Bill had been agreed with a Negotiating Committee of the County Councils' Association, and the proposal was that the county councils should " take over " small holdings next year on the basis of a self-supporting undertaking for which thereafter they will be themselves entirely responsible. He announced also that

the present Merchandise Marks Bill would not be proceeded with this year, but would be incorporated in a wider and more comprehensive Bill next session.

The Minister concluded his address with a statement of the present position of Foot-and-Mouth Disease which had recently broken out in the country on a larger scale than it had reached for a year or more. It was imperative if the disease was to be quickly stamped out that farmers should report suspicious symptoms in their cattle, sheep or pigs immediately, otherwise the damage would be done before the Ministry and the local authorities could get to work.

Mr. Walter Smith and *Mr. Acland* asked questions as to the number of new houses provided in rural districts and whether they really met the needs of agricultural workers. *The Minister* undertook to get from the Minister of Health information on these points for the assistance of the Council. *Mr. R. G. Patterson* (Staffs), *Lord Strachie*, *Col. H. E. Disbrowe-Wise* (Derby), and *Mr. Owen Webb* (Cambs.) asked questions in regard to Foot-and-Mouth Disease, particularly as to the steps taken to prevent infection from the Continent, to which the Minister replied that he was proposing to take whatever action was practicable, and would be glad to consider any further measures that might be proposed. *Mr. W. B. Taylor* (Norfolk) asked as to the terms of settlement of the 1926 Valuation of small holdings, and *Mr. H. W. Thomas* (Hants), *Mr. R. G. Turton* (North Riding) and *Mr. J. Egerton Quested* (Kent) asked as to the sheep scab policy, to which the Minister replied.

Lord Clinton moved a vote of thanks to the Minister, and regretted that it had not been possible for him to say anything upon the Council's proposals in regard to Agricultural Policy, although he recognised that the course which was proposed to be followed in regard to the arrangement was the constitutional one, viz., of submitting a government policy first to Parliament. The vote of thanks was carried unanimously.

Report on Pooling of Surpluses of Approved Societies N.H.I. —*The Rt. Hon. F. D. Acland*, Chairman of the Standing Committee of the Council, moved the adoption of the Report from that Committee on the question of the pooling of surpluses of Approved Societies, National Health Insurance. *Mr. Walter Smith* said he rather regretted the form of the illustrations which had been adopted in presenting the case to the Royal Commission on National Health Insurance. It was suggested that the low wages of agricultural labourers were acceptable because

of the healthy conditions of their employment. He believed that far from the healthy conditions being an attraction, the case in that respect was bad enough, but the Report went further and said that in normal times the miner was paid a liberal wage because his work was both arduous and hazardous. It was remarkable that a Royal Commission after exhaustive consideration had come to the conclusion that the miner was rather underpaid than otherwise. The Report was received by the Council.

Fees for Certificates under the Agricultural Holdings Act and Rent Restrictions Act.—*Mr. Acland* moved the adoption of the Standing Committee's Report on the question of the fees which ought to be charged for those certificates by county authorities. *Mr. J. S. Gibbons* (Glos.), *Mr. R. W. Hall* (Hereford), *Mr. W. B. Taylor*, and *Lord Chichester* (East Sussex) commented upon the Report, Lord Chichester suggesting that the last sentence should stop after the words "average cases," and the words "and the fee should be charged to the party against whom the decision is given" omitted. He said that the important thing was that the authority should get the fee and the sooner the fee was paid the better. It should therefore be paid by the applicant. Indeed, only if the fee were paid, should the applicant get the certificate. The Report was agreed with the alteration suggested by Lord Chichester.

Report on Co-operative Purchase.—*Mr. Acland* then moved the adoption of the Report of the Standing Committee on the subject of the recently issued Report on the Co-operative Purchase of Agricultural Requisites. The Standing Committee wished to commend this Report to members of the Council in the same way as a few months back they had been able to commend the Report on the Co-operative Sale of Agricultural Produce.

Suggestion to License Potato Importations.—*Mr. James Hamilton* (Lancs) moved :—

> "That in order to stabilise the price of potatoes, this Council recommends that in future potatoes shall not be imported except under licence given on the recommendation of the Potato Advisory Committee when in their opinion the wholesale price of home-grown potatoes is such as will cover the cost of production with a reasonable profit to the producer."

In the course of his speech, Mr. Hamilton said that foot-and-mouth disease infection had been ascribed to potato bags; that subject was, however, apart from what he had in view

in proposing the resolution. The annual crops of potatoes in this country varied from scarcity to surplus. To protect the industry in years of a plentiful crop it would be an advantage to limit importation. The Potato Advisory Committee, made up of importers, merchants, distributors and producers, could be trusted in the matter. He would suggest two additional members to represent consumers. *Mr. H. C. Gardner* (Worcs.) seconded the resolution. *Mr. George Edwards* spoke against it, instancing the case where the Council had recently opposed the restriction of the importation of manufactured manure. The object of the resolution was to raise the price of potatoes. In some years the market price of potatoes very much more than paid for the cost of production. *Mr. H. W. Thomas* supported the resolution because its intention, as he saw it, was rather to stabilise the price of potatoes and make it possible for the potato grower to keep up a constant supply. The three reasons why potatoes should be singled out for attention, in his view, were (1) that enough could be grown for all home requirements; (2) that the crop carried a large amount of labour; and (3) that the smallholder could grow potatoes in competition with the large farmer.

Mr. Walter Smith opposed the resolution, as by it potato growers would have all the advantages arising from a good market and be protected from the disadvantages of a bad market, a one-sided deal to which the consumer would naturally raise objection. He thought that the break in prices in 1922 would have occurred whether potatoes were imported from abroad or not; an abnormal acreage had been put down and there was a large crop. He thought it would be a better thing if agriculturists, through their organisations, could come to some arrangement so far as acreage was concerned, and also arrange to market their crops co-operatively, not leaving themselves so much in the hands of merchants. *Mr. R. L. Walker* (Yorks W.R.), a large potato grower, also opposed the resolution, which he did not think a practicable one. He thought that farmers could only work their profit in the potato market over a series of years. Wherever potatoes are being grown on suitable land the value of that land became enhanced. There was good land for potatoes and bad land, and if Lancashire could not grow good quality potatoes, why not try beef? *Mr. Denton Woodhead* also opposed the resolution and advocated co-operative selling. *Lord Bledisloe*, Parliamentary Secretary to the Ministry, stated that there were certain treaty obliga-

tions with other countries which stood in the way of the proposal. No large quantities of potatoes were coming from Germany. In 1922 importation equalled not more than 3½ per cent. of the home crop, and in that year Holland sent us potatoes instead of sending them to Germany. The restriction on the importation of potatoes from America last autumn was caused through the danger of the Colorado beetle. *Mr. Hamilton* replied to the debate, upholding his motion which was, however, put to the meeting and lost.

Excise Duty Suggested for Foreign Malt and Malting Corn.—*Mr. Owen Webb* moved the following resolution:—

> "That in order to help to maintain the arable land of Great Britain under a proper state of cultivation, and to permit of the economic production of British Malting Barley, whilst all Foreign Corn entering into Great Britain is admitted free of Import Duty, it is urgently necessary that an Excise Duty of 20s. per qr., 336 lb., be levied on all Malt made or manufactured from Foreign Corn, and all raw Foreign Corn used for the purpose of brewing in Great Britain."

He said that there was a fair market for first-grade barley grown in this country, but in regard to second-grade barleys there was great competition arising through the importation of similar barleys from abroad. His suggestion was, that the duty instead of being placed on the barrel of beer, should be put on malt and other products of foreign origin which go into beers. This would not interfere with farmers and others who required foreign barleys for feeding purposes. The result of the proposed duty would be so small—9½d. on the cost of a barrel of 36 gallons—that it could not very well be handed on to the consumer. At Cambridge Market, there was practically no sale for barley except of the finest malting quality; and it was not possible for farmers to grow barleys at the prices now offered for the lower qualities. In the eastern counties, there were large numbers of barley-maltings which were empty. Better prices would be obtained if these were opened and used. There would be very little opposition to the resolution from the trade itself. Neither the brewer, the maltster, nor the merchant would be likely to object to it. *Mr. Raby* (Essex) seconded the resolution; *Mr. R. G. Patterson* opposed it on the ground that the Prime Minister had pledged himself against such action. *Mr. George Edwards* opposed it on the ground of the requirements for good cultivation. He did not want to encourage the farmer to grow cereals continuously on the same land. *Capt. E. R. Morris* (Herts) said that a large proportion

of the land on which barley was grown to-day was in danger of going out of cultivation. Labour should realise that it was useless to think of continuing to protect wages if something was not done to protect the industry which paid the wages. The proposal in the resolution, which he strongly supported, only meant 9½d. on 36 gallons of beer, but it meant a big difference in the price of barley and would help to provide a market for that cereal. Arable farming was very much in need of assistance, and the Government should realise the position speedily before it is too late. *Mr. W. B. Taylor* said that the Prime Minister was definitely committed to a policy which could not include the present proposals. It seemed to him that the brewers and the Farmers' Union should put their heads together in endeavouring to give assistance in the present problem. *Mr. Webb* replied to the debate. The motion was then put to the meeting and declared lost by 16 votes to 14.

Tithe Bill.—*Mr. H. W Thomas* moved :—

> "That this Council, while anxious for a fair solution of the tithe question, is of opinion that the terms of the Tithe Bill are very unfair from the Tithepayer's standpoint."

Mr. Thomas reminded the Council of the low price of cereals now as compared with 1836 when the Tithe Commutation Act was passed. The cost of production since 1836 had gone up enormously. In those early years with a bad harvest in the country, prices of grain would go up considerably, but not so to-day. The Tithe Bill if passed in its present form would mean a grave injustice to many farmers, especially to those who had recently become owners. He instanced, also, the favourable terms of redemption allowed by the Irish Church Act of 1869. *Lord Strachie* seconded the motion, stating that the great blot in the Bill was compulsion. He considered the Act of 1918 gave very fair terms without compulsion, but the Act of 1920 was very advantageous to the clergy, relieving them of a large part of their local rates. *Mr. G. E. Hewitt* also supported the resolution, which was put to the meeting and carried.

1926 Valuation of Small Holdings.—*Mr. R. C. Grey* (Hunts) moved :—

> "That this Council views with apprehension that under the present proposal in regard to the valuation of Councils' small holdings estates in 1926, the whole of any loss which may arise after the valuation will have to be borne by rates, and suggests that the Ministry be approached with the view of pressing for the incorporation in any proposed new legislation of a provision for the payment to Local Authorities of one-half of any such loss."

Mr. Grey asked why it was that County Councils should now be asked to shoulder the entire responsibility for small holdings after 31st March next. By taking the Ministry out of its share of responsibility, the whole scheme for small holdings was considerably damaged. He explained in how many ways he considered that the movement would lose by this. *Mr. W. B. Taylor* seconded the resolution, which he approached from a different standpoint to the mover. He thought it would be better if the Ministry would give an assurance that in the " take-over " in 1926 they would take into account the present very high rents that existed on some small holdings as compared with those on similar land under private ownership. There would certainly be a serious loss in the event of one or two bad seasons if these rents were continued. *Mr. J. S. Gibbons* (Glos) opposed the resolution. So far the Government had paid all the loss and would do so up to 31st March next year. In Gloucester, there had been a drastic revision of rents for small holdings two years ago in which the county was very fairly met by the Ministry. The rents were now fair and not above the standard for the district. With the change next year there would, of course, be less Government control. *Mr. R. W. Hall* and *Mr. A. Matthews* supported Mr. Grey's resolution and *Mr. E. V. Wheeler* (Worcs) opposed it. *Lord Bledisloe* addressed the Council on the subject, explaining the intentions of the Government, which were to put the small holdings scheme once more on a self-supporting basis. with a greater degree of local autonomy. *Mr. A. R. White* (Wilts) supported the agreement which had been come to between the County Councils' Association and the Ministry, and opposed the resolution. *Mr. Grey* replied to the debate, and the motion was then put to the meeting and lost.

Durham Schemes of Land Drainage.—*Mr. Thomas Davis* (Durham) moved :—

> **"That strong representations be made to the Ministry of Agriculture and Fisheries asking for authority to carry on in Durham Schemes of Land Drainage during next year, including the summer months, in view of the acute depression and unemployment existing in that County."**

Mr. Davis pointed out that in Durham there were many people unemployed, mostly miners. The Land Drainage Schemes, if worked in the summer, would give them employment. *Mr. Walter Smith* seconded the motion. as a very modest request, first, on account of the importance of land drainage, and second, on the value to the nation of employing unemployed

who may be now drawing the "dole." *Mr. A. R. White* said there was great opposition in Wiltshire to such schemes as those referred to being carried out during the summer months, when men were required for harvest and other work on the land. *Lord Bledisloe* said that there was no very large amount of unemployment amongst agricultural workers and supported Mr. White in his statement that they were required in the summer for work on the land. There was, however, a largely extended scheme of drainage under consideration by the Government at the present time, and the Ministry was hopeful of getting a grant to enable them to carry it out. The Durham conditions of labour were exceptional, but the Drainage Schemes were not intended to mitigate urban unemployment. *Major Fawkes* asked what wages would be paid in Schemes in Durham: in the West Riding of Yorkshire it was, he said, the minimum agricultural wage of the district, which would be insufficient for the needs of urban dwellers. *Mr. Davis* replied that the rate fixed by the Ministry in previous cases—he thought it was an average of about 10d. an hour—had been accepted. The motion was then put to the meeting and carried.

Agricultural Advisory Committee's Report.—The adoption of the Report (No. 11) of the Proceedings of the Agricultural Advisory Committee for England and Wales was moved by *The Chairman* and agreed.

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AGRICULTURAL ADVISORY COMMITTEE FOR ENGLAND AND WALES.

REPORT (No. 11) to the Councils of Agriculture for England and Wales on the Proceedings of the Agricultural Advisory Committee. This report covers the proceedings at two meetings which have been held since the last report was presented, namely, those on 1st July and 7th October, 1925. At the meeting on 1st July, the Minister welcomed Mr. William Edwards, who had been appointed to the Committee in place of the late Mr. John Roberts, by the Council of Agriculture for Wales.

(1) **Sheep Scab.**—The Committee considered the Ministry's new proposed policy in regard to Sheep Scab as set out in a Draft Order which was placed before them. The basis of these proposals is the general compulsory double dipping of all sheep in the country, accompanied by movement restrictions, limited

to a comparatively short period of each year (15th July to 31st August), the remainder of the year being free from restrictions or from the requirements of dipping on movement. The new plans, however, provide for the exemption of whole counties which have been free from scab for the preceding two years, subject to proper conditions which will safeguard such counties against the risk of the reintroduction of the disease. The matter was carefully discussed by the Committee and the proposals in general agreed.

(2) **Register of Movements of Live Stock.**—A further Draft Order was considered and agreed to by the Committee provided that it was ensured by it that in the event of an outbreak of Foot-and-Mouth Disease through a dealer's cattle, the dealer could be traced through the register, even though he had no settled abode or premises in this country. The object of the register is to provide a more complete means of tracing animals in outbreaks of Foot-and-Mouth Disease.

(3) **Compulsory Registration of Bulls.**—The Ministry placed before the Committee a scheme for consideration in which the following were the chief points:—

(1) No bull over ten months old to be used for service unless licensed; (2) Ministry's officers to carry out licensing and examinations; (3) bulls to be taken, if practicable, to centres for examination and not dealt with on owner's premises; (4) licensed bulls to be properly earmarked; (5) appeals in regard to rejected bulls to be heard by a panel of referees in the county; (6) owners of rejected or unsound bulls to be required to slaughter or castrate them; (7) a fee of 10s. to be charged for licences if bull examined at home, and 5s. if examined at prescribed centre.

The scheme was considered, and the Committee expressed itself in favour of the Minister proceeding with the scheme and having a Draft Bill prepared which would come before the Committee for their further consideration.

(4) **Reduced Compensation in Certain Foot-and-Mouth Disease Cases.**—The Committee considered and approved a proposal put before them by the Ministry not to accede to the suggestion to pay a reduced scale of compensation for seriously-diseased animals in Foot-and-Mouth Disease cases in order to encourage farmers to report earlier and so save the spread of the disease.

(5) **Tuberculosis Order.**—The Committee considered the Draft Tuberculosis Order and approved it.

(6) **Detention of Cattle from Ireland.**—It was agreed that the position in regard to Foot-and-Mouth Disease had improved sufficiently to permit of reversion to the statutory period of six days' detention in the case of cattle from Ireland in place of the 28 days which had been substituted during the time when Foot-and-Mouth Disease was so generally prevalent.

(7) **Foot-and-Mouth Disease.**—At their Meeting on the 7th October the Committee considered the position in regard to the recent outbreak of Foot-and-Mouth Disease at three centres in the south of England. In view of the menace which threatened the country by reason of the very large increase of outbreaks recently on the Continent, it was decided that the various possible channels by which infection could be brought from the Continent should be again closely examined with a view to a reduction of our risk.

(8) **The Use of Arsenical Sheep Dips.**—The question was raised whether the use of arsenic in the sheep dips approved under the Ministry's Sheep Scab Order, should be allowed in view of the recent deaths which had been attributed to the excessive and ill-advised use of arsenic. It was agreed that the general authority to use arsenical sheep dips should be withdrawn and only dips with a very small percentage of arsenic permitted for statutory dipping under the Scab Orders.

(9) **Reports of Proceedings of other Committees.**—During the period covered by this report two reports on the proceedings of the various advisory and departmental committees of the Ministry were presented and examined.—*19th October, 1925.*

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DOWNY MILDEW OF MANGOLD AND BEET.

PROF. E. S. SALMON and W. M. WARE, M.Sc.,
Mycological Department, South-Eastern Agricultural College, Wye, Kent.

THE fungous diseases to which the root crops, beet, sugar-beet and mangold, are liable in this country are not numerous, and with the exception, perhaps, of heart-rot of mangolds, they have seldom been responsible for any appreciable loss. In view, however, of the steadily increasing acreage devoted to the sugar-beet crop it seems desirable to draw the attention of farmers and seedsmen to the fact that one at least of these diseases is

capable of causing considerable damage if allowed to become established.

The Downy Mildew, sometimes called "False" Mildew, (*Peronospora Schachtii*) has long been known on the Continent as a source of trouble to the sugar-beet grower, and was first described by Fuckel, a German investigator, in 1865. Its presence in Great Britain may have been suspected, but the first authentic record of the occurrence of the disease was established by Mr. H. H. Stirrup in 1921, when it was reported as destroying sugar-beet foliage near Ely (Cambs.) and Spalding (Lincs.).*

During the first week of June, 1925, the attention of the writers was called to an outbreak of the present disease on a mangold crop which was being grown for seed in east Kent. The area affected was visited in July; it consisted of six acres planted with the variety "Red Intermediate" in rows two feet apart and with two feet between the plants in the row.

The "roots" were of "seed" size (3 to 4 in. diameter) and in those parts of the field where no disease occurred the main stems had grown up strongly and had been pinched off at a height of three or four feet, according to the usual practice, to secure more lateral growth. In the diseased areas of the field, plants were either missing (having rotted away) or showed a thickened and stunted main stem about a foot high, and usually several thin secondary stems arising from the side of the crown or "root." The large, outer leaves were healthy, though being older they naturally drooped somewhat and were often slightly tinged with yellow. On the main stem and at its base, the smaller leaves were twisted, puckered and thickened. Their under-surface was felt-like and of a soft buff-grey colour, being covered entirely with the dense spore-bearing fructifications of the Downy Mildew (Fig. 1).

It was found that affected plants, even those with apparently healthy secondary shoots, were becoming decayed. A black rot had started at the top of the crown; and, in more advanced cases, the secondary stems were wilting. This was probably due to later infection by other fungi or bacteria following injury caused by the Downy Mildew.

In parts of the field it was estimated that 10 per cent. of the crop was diseased; but taking the whole six acres into consideration the damage probably did not amount to more than 2 or

* Ministry of Agriculture and Fisheries: Fungus Diseases of Crops, 1920-1921. Misc. Publications No. 38, p. 39. London, 1922.

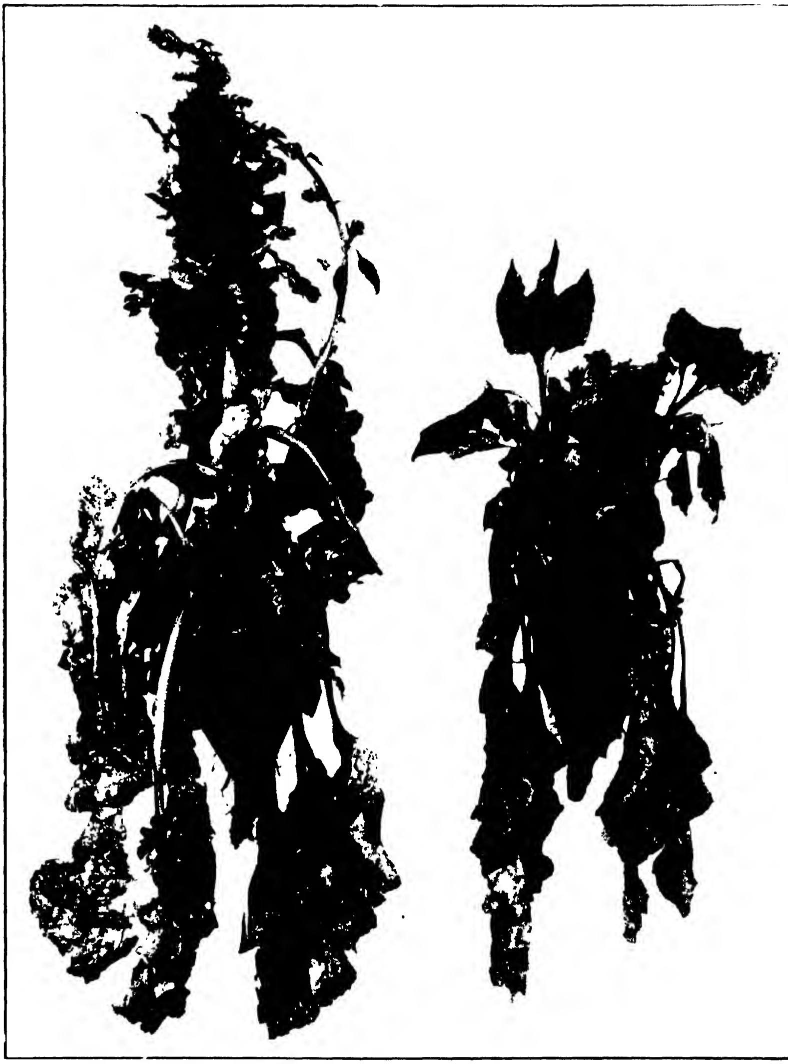

FIG. 1. *Peronospora Schachtii.* The mangold plants, grown for seed, attacked by the Downy Mildew, showing permanently stunted main stems. Healthy lateral shoots can be seen arising from near the top of the "crown." The twisted, puckered leaves of the main stems are thickly covered with a felt-like mass consisting of fructifying branches of the fungus like those shown, highly magnified, in Fig. 2 (¼ nat. size).

3 per cent. Actual counts were not made by walking through the crop because the brittle stems and laterals of the plant are easily damaged at the stage of growth reached in July.

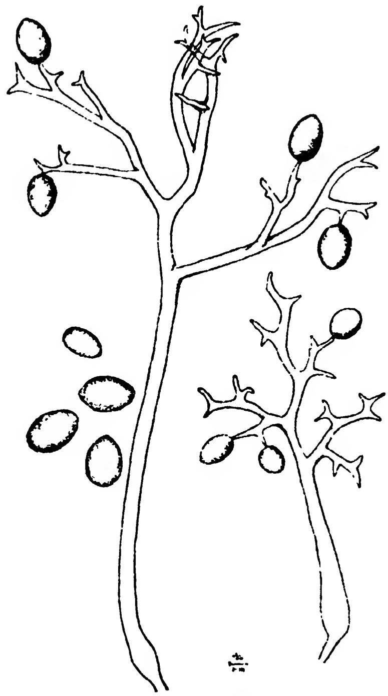

Fig. 2. *Peronospora Schachtii.* Two fructifying branches (*conidiophores*) of the Downy Mildew of the Mangold, showing some spores (*conidia*) still attached ; others free. × 250.

Plants were pulled up and examined in the laboratory, when it was found by means of hand sections that the spawn (*mycelium*) of the fungus* was present in the upper part of the "root," viz., in the portion known as "hypocotyl," above the level of origin of the two rows of fibrous lateral (true) roots. Thence it was traced in the main stem and was found present in the leaves.

From the under surface of the leaf there projected crowded masses of fungus branches (*conidiophores*) each of which bore several spores (*conidia*). The latter are readily detached and distributed to fresh leaves or to fresh plants by the agency of wind or rain. (Fig. 2.)

No winter resting-spores (*oospores*) were found in the plants examined. The weather having been dry and warm, it is possible that at that time of year (July), winter-spores had not

* The *mycelium* was clearly visible on using Azo Blue stain.

been formed. On the Continent formation of resting-spores (*oospores*) in the leaves has been noted.

Origin of the Disease.—With regard to the origin of the disease in any particular season, there are several possibilities. If, as is known to occur abroad, *oospores* are formed in the diseased parts, they could readily cause infection of the soil in the seed beds and, germinating there, give rise to the disease in any crop of beet or mangold that might follow. Not only seed beds but also the fields themselves might be thus infected.

The second possibility is that the disease is seed-borne, in which case the young plants in a seed-bed or in a field crop would become infected at the time of germination. Although this possibility has never been thoroughly investigated, there are grounds for supposing that seed infection may occur.*

The sudden appearance of the disease in a crop being grown for seed may be accounted for by the fact that the spawn (*mycelium*) of the fungus can overwinter in the crown of the "root." Having obtained entry into the seedling plants growing in the seed-bed, either by means of *oospores* germinating in the soil, or by seed infection, or by means of summer-spores (*conidia*) being blown across to the seed-bed from neighbouring crops of beets or mangolds, the fungus can remain in a dormant condition within the "root" of the young plant. Little damage, except to the heart leaves, may result during the first season, but when the roots are planted out in November they will carry with them the spawn (*mycelium*) of the fungus which will start growth within the main stem when this sprouts in the following spring. About April the damage caused by stunting and thickening of the stalk and killing of the stem leaves will first become apparent and will increase if the weather conditions are favourable.

In the case under consideration, the nearest crop of beets or mangolds for seed was about 4 miles away, though beetroots were being grown nearer, on the same farm, within a quarter of a mile, and doubtless also in gardens in the neighbourhood. If these are assumed to have been healthy, then the disease must be supposed to have been already established within the "roots" when these were planted out.

The young plants were derived from seed sown on 14th August of the previous year (1924) on part of a field situated a quarter

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* Eriksson, J. Phytopathologische Mitteilungen I. Reprinted from *Arkiv för Bot.*, XIX, 6 1924. Abstr. in Rev. App. Mycology III, 1924, p. 729.

Anon.: Plíseň řepná (Mildew of Beetroot) *Ochrana Rostlin*, III, 3-4, 1923, p. 32. Abst. *ib.*, p. 565.

of a mile away from the six-acre field on which the disease became apparent. This seed bed occupied only a strip of the field which was then cropped (August, 1924), in the following order, with beets, sprouts, mangolds, cauliflowers, broccoli, mangolds. The seed-bed area was between the sprouts and cauliflowers but quite close enough to beets and mangolds for infection of the seedling plants to have taken place from these, if the possibility of original infection of the seed itself. or of the presence of *oospores* in the soil, be disregarded. No mildew, however, had been noticed by the farmer that autumn on either of these adjoining root crops up to the time of lifting.

Control Measures.—Should this disease become of common occurrence. especially in areas devoted to the sugar-beet crop, it will cause serious damage (1) by reducing the amount of seed grown per acre; (2) by killing, or rendering useless, seedling plants in the seed bed; (3) by reducing the number or weight of " roots " grown per acre; (4) by reducing the sugar content of any " roots " harvested which may have been attacked even though only on the heart-leaves of the foliage.*

The following measures of control, based on experience of this disease as it affects the sugar-beet crop, have been advocated on the Continent :—Seed-beds in which the young plants are raised in late summer should be situated as far away as possible from any field crops of mangolds or beets, or at least in a position not directly in the line of prevailing winds which can first pass over such root crops. The position of the seed-beds should be altered each season owing to the danger that resting-spores may remain in the soil after one diseased crop has been raised. In Denmark the increase of Downy Mildew on mangolds and beets in 1921 was thought to be due to the fact that seedsmen's nurseries afforded numerous opportunities of early infection. Seed, whether for spring sowing or for raising small seed " roots," should be saved only from healthy plants and it has been recommended that should the disease appear in a field for seed, an inspection should be made and any plants showing the mildew should be pulled and destroyed. If the symptoms can be recognised in the young plants from the seed-bed, these plants should of course be rejected at the time of planting out. and it is then probable that no serious outbreak will occur in the crop in its second season.

In the case of a root crop, resting-spores formed in the leaves will contaminate the soil. For this, rotation of crops is the

* Prillieux, E., Maladies des Plantes Agricoles. I. p. 138, Paris. n.d. Peters, L., Die Kräuselkrankheit der Rüben. *Deutsche landw. Presse*, 50. 1923, p. 117.

only practical remedy. Diseased tops should not be carried, by any means, to other parts of the farm. Fungus diseases of many crop plants are known to occur also on common weeds of the farm, but the wild beet (*Beta maritima*) found near the seashore is the only wild plant which this mildew is known to attack and which might, therefore, provide in certain districts a possible source of infection of the cultivated plant.* Spraying with Bordeaux mixture has been recommended to prevent the spread of the disease during the growing season.

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THE SUMMER PRUNING OF FRUIT TREES.

H. GOUDE, N.D.H.,

Horticultural Superintendent to the Norfolk County Council.

FROM a physiological point of view it is more correct to prune and train fruit trees during active growth than in the period of suspended functional action during winter. The chief objection to summer pruning is usually one of expediency which may be defined as lack of time. With the increasing cultivation of choice dessert apples in commercial plantations there is a marked tendency, however, to revive old-time methods and to give attention in summer to directing the energies of the tree to channels of utility and to the elimination of useless wood.

Interest in the success of summer pruning in this district was aroused some years ago by an inspection of plantations at Framingham Pigot. Old pear and apple trees had been brought back to perfect health and fruitfulness by close summer pruning. The fruit produced has won numerous prizes and awards in Norwich and London in open competition. This success is remarkable when it is remembered that fruit culture had been regarded as hopeless on this soil and particularly for the cultivation of pears. The pruning adopted at first was Lorette's method of summer shoot cutting, but Lorette had been preceded by Charles Harrison, who published in 1823 "A Treatise on the Culture and Management of Fruit Trees," a book that is very precisely written on a system that is, for all practical purposes, identical with Lorette's. The Framingham trees are now an excellent demonstration of Harrison's practice.

Good as both Lorette's and Harrison's systems are, they appear, botanically, to be wasteful to the trees' energies, as shoots are allowed to grow twelve inches or longer, to become

*It is sometimes stated that the present fungus (*Peronospora Schachtii*) occurs on Goosefoot (*Chenopodium album*), a common weed of arable land. The recent investigations of Gäumann, however, have shown that this is not

half ripe and are then cut severely back. In addition complications easily arise with beginners owing to the various methods advised, in Lorette's practice, for cutting different shoots.

Three years ago it was decided to allow a few bush apple trees to grow shoots just where they were required for forming the branches and to pinch all the side shoots to four or five leaves. These pinched side shoots then developed the bud in the axil of the top leaf. As soon as this was seen it was rubbed out without injury to the leaf, from the axil of which it grew. Two buds then developed, one on each side of the scar made by pushing out the first shoot, and although many of these grew into weak shoots, a good number developed into blossom buds the first season. These buds flowered the following spring and carried normal fruit. After the first season's experience other trees were marked out for an extended trial.

Trial at Burlingham.—A most successful trial is developing on the Norfolk Agricultural Committee's demonstration plots at Burlingham. Here most of the commercial varieties of apples are producing respectable crops of fruit on trees planted as one-year maidens on crab stock in March, 1923. After planting, all these trees were cut back to about 3 ft. from the ground. Only three shoots were allowed to grow round the stem for forming the tree. All other shoots were pinched back as soon as four leaves could be seen, and the resulting shoots from this pinching rubbed out. The leading shoots were allowed to grow during the summer. The trees only made growth where it was required. An effort was made to balance the three shoots by pinching any that were over strong and running away from the other two. If this pinch is made when a strong leader has made about fifteen inches of growth it will push one shoot for the leader from the first leaf axil. The weaker shoots then have time to even up in strength as they are not stopped. This gave us a batch of very fine one-year planted maidens. To secure the requisite number of branches the three leaders were cut back in the early winter of 1924 to about one-third of their length. The strongest growths were left longer than the weaker shoots. The summer-pinched side shoots were not touched if they had developed fruit buds. Those that had not were cut to the top bud that could be seen. This left rather long spurs. Exactly the same system was followed the second summer. All the unwanted shoots were pinched, and only those retained that were correctly placed. No useless wood had been grown, and

the amount of wood to remove at the winter pruning consisted of shortening the leaders; a few handfuls from two acres of trees. Most of the side shoots that failed to develop fruit buds the first season have done so this year on the wood that carried the first four leaves. They will be cut to these buds this winter to give closer spurs. The Bramley, Newton, Annie Elizabeth, and Beauty of Bath that have sufficient main branches will not be winter-pruned again, and the Worcester also are strong and few need cutting back. The weaker growers—Allington, Cox, Stirling, etc., will have their leaders cut back to strengthen the branches, but it is also intended to try some of them without shortening the leaders, and thinning the fruit to prevent the weaker branches from being pulled out of shape by too much weight of fruit.

On the older trees every shoot is pinched at four leaves, including the leaders where no extension is desired. This is followed by rubbing out every growth as soon as it can be seen that it will develop into a shoot. Consequently the tree only has the primary leaves left on the pinched shoots. These are the most important leaves for fruit production. All the others are wasted developments and useless to the tree. After the first pinch on the side shoots, the resulting shoot is rubbed out; while the two shoots are developing one each side of the scar, and the bud in the axil of the next leaf, which usually grows, is also rubbed out. It has not been noticed that any further buds develop on these shoots from the axils of the primary leaves. It is commonly stated in gardening lore that shoot growth develops root action. A few trees were taken up for comparison with trees untouched during summer but no noticeable difference could be detected and appearances were in favour of the shoot-pinched trees.

Advantages of the System.—The system is simple and the trees require less attention after the first season, and certainly less time than Loretting. The method has also been applied with considerable success to grape vines for eight years. It is based on the principle of allowing the tree sufficient of the first formed leaves to mature the fruit. All the others are suppressed except where growth for forming new branches or extension of branches is required.

The known processes of photosynthesis fully support this method of treatment. It is the young leaves round the growing points that actively elaborate food material for growth. The primary leaves of the pinched shoots and spurs are slower in

FIG. 1.—Shoots cut from branch after pinching at the fourth leaf: (2) shows first growth from the axil of the top leaf: this growth is rubbed out. In (3), (5) and (7) the double shoots that develop after first growth are rubbed out. In each of these shoots the double growth is broken out. In (1), (4), (6) and (8) blossom buds are forming.

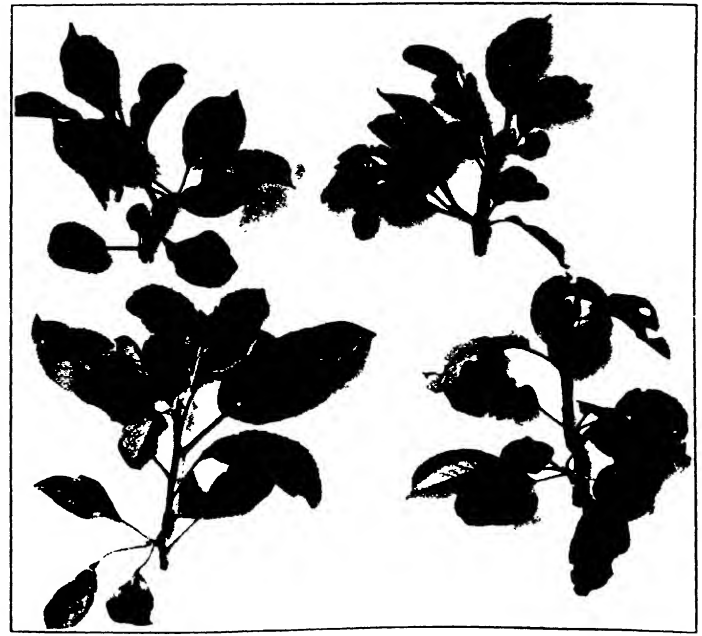

FIG. 2.—Two-year old spurs, that did not make blossom buds the first season. These were autumn-pruned to two buds, and next season's shoot treated by pinching at the fourth leaf. Blossom buds develop on the two-year old and current season's wood.

Photographs taken in mid-July.

FIG 3.—Ellison's Orange, on Crab stock, in fruit under the system of summer pinching, planted as a one-year maiden in March, 1923.

FIG. 4.—Cox's Orange Pippin, on Crab stock, in fruit under the system of summer pinching, planted as a one-year maiden in March, 1923.

action and build up the food for developing blossom buds and fruit. This season at Framingham, plum trees have been pinched as directed for apples. The results appear to be satisfactory but it is too early to give a definite opinion on the system with plums or pears.

The illustrations of the young trees, on crab stock, which are average specimens at the plantation, indicate the value of pinching in the early years of trees that will eventually grow to a large size. The colour and size of the fruit is increased, and the method is easily applicable to any apple trees that admit of summer pruning.

The fruit spurs are attended to as soon as the fruit is picked, thinning out the spurs where they are too thick, and reducing the fruit buds to one or two at the most on each spur. After October is in, the leaders are cut back if necessary. They are not being cut back unless it is essential to make growth break to furnish new branches or to strengthen branches of weak-growing varieties. If it is necessary to shorten a branch, cutting the strong leader is preferred to a weaker side growth, or to a summer pinched shoot. The physiological theory on which the whole system is based is that the strong growth has developed equally strong vascular bundles, giving high tension sap pressure and rapid secondary growth when cut back—hence the over production of wood from cutting back either shoots or leaders. The pinched shoots do not develop this tendency to make strong secondary growth. In the early years of any fruit plantations the system gives earlier fruiting and larger trees, as their energies are directed. It cannot be followed on standard trees as they outgrow accessibility.

The trees on dwarfing stocks are placed under full control, and young trees on vigorous crab stock readily develop blossom buds under this system of management.

It is important to safeguard the primary leaves retained on the tree, from attacks by caterpillars or fungi, although the tough leaves developed under this system do not readily fall a prey to attacks from insects or fungi. As a prevention the trees are sprayed each season with lime-sulphur, $2\frac{1}{2}$ gallons to $97\frac{1}{2}$ gallons of water, to which is added super-arsenate of lead powder for the caterpillars, as the blossom is opening. Cox's and Beauty of Bath, two tender varieties, were not injured in the leaves or blossom, nor any other variety by this spraying immediately before the blossoms open. Later, spraying with lime-sulphur at reduced strengths did damage the leaves and fruit in spraying trials.

LICENSING OF STALLIONS UNDER THE HORSE BREEDING ACT, 1918.

THE complete figures now available for the licensing year ended 31st October, 1925, show that the decline in the number of stallions licensed in England and Wales under the Horse Breeding Act, 1918, has continued. The total number of licences issued for the service season of 1925 was 1,849, as compared with 2,210 in 1924; 2,761 in 1923; 3,479 in 1922, and 3,816 in 1921. The following table shows that the decrease is again much more marked in the case of shire and other heavy stallions, than among other breeds :—

Service Season	*1921*	*1922*	*1923*	*1924*	*1925*
Shires	2,463	2,174	1,631	1,195	953
Other heavy horses ...	636	591	486	424	350
Light horses (including ponies) ...	717	711	641	591	516
Totals ...	3,816	3,479	2,761	2,210	1,849

In connection with the decline in the number of heavy stallions travelling for service, reference may be made to the Ministry's Scheme for the improvement of heavy horses which was reinstated in 1924, and which it is hoped will do something to encourage the revival of breeding, especially among the small farmers who ceased breeding altogether in face of the conditions arising out of the War, and the temporary withdrawal of the Ministry's scheme in 1922. This scheme made slight progress during the service season of 1925 and it is hoped that in due course it will tend to assist in the recovery of the heavy horse breeding industry. Particulars of the scheme may be obtained from the Ministry.

Notwithstanding the somewhat serious position indicated above, it is satisfactory to note that the main object of the Horse Breeding Act—the elimination of the unsound travelling stallion—has been achieved in a very large measure. During last season, only two unlicensed stallions were reported on the road, and in both cases proceedings were instituted by the police and resulted in convictions. Six licensed stallions were reported as travelling unaccompanied by licences, and in two of these cases the grooms in charge were prosecuted.

Table I.

	Heavy Breeds					Light Breeds									Pony and Cob Breeds									
Pedigree Stallions:— i.e., Stallions entered or accepted for entry in the recognised stud book of their breed.	Shire	Clydesdale	Suffolk	Percheron		Hackney	Thoroughbred	Arab	Cleveland Bay	Welsh Roadster	Hunter	Yorkshire Coach	American Trotter		Welsh	Fell	Dales	Polo and Riding	Shetland	Highland	Dartmoor	Welsh Cob		
Licensed	918	125	146	47	—	133	152	15	6	2	5	3	—	—	26	21	18	22	6	—	—	65	—	1,710
Refused	32	2	3	2	—	4	10	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	54
Applications	950	127	149	49	—	137	162	16	6	2	5	3	-	—	26	21	18	22	6	—	—	65	—	1,764
	Types					Types									Types									
Non-Pedigree Stallions:— i.e., Stallions not entered or accepted for entry in a recognised stud book.	Shire	Clydesdale	Suffolk	Percheron	Others	Hackney	Thoroughbred	Arab	Cleveland Bay	Welsh Roadster	Hunter	Yorkshire Coach	American Trotter	Others	Welsh	Fell	Dales	Polo and Riding	Shetland	Highland	Dartmoor	Welsh Cob	Others	
Licensed	35	4	1	—	27	18	—	2	1	1	3	—	5	6	4	—	8	2		—	—	14	8	139
Refused...	1	—	—	—	1	1	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	5
Applications	36	4	1	—	28	19	—	2	1	1	3	—	6	6	5	—	8	2	—	—	—	14	8	144
Total Licensed	953	129	147	47	27	151	152	17	7	3	8	3	5	6	30	21	26	24	6	—	—	79	8	1,849
Total Refused	33	2	3	2	1	5	10	1	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	59
Total Applications ...	986	131	150	49	28	156	162	18	7	3	8	3	6	6	31	21	26	24	6	—	—	79	8	1,908

Stallion owners in possession of licences for the year ended 31st October, 1925, are reminded that these licences expired on that date and should have been returned to the Ministry. Applications for renewals, as well as for new licences, should be made as early as possible on forms which may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

Table II.

BREED.	Number of Applications.	Number of Refusals.	Per cent. of Refusals.	REASON FOR REFUSAL.									
				Roaring.	Whistling.	Sidebone	Ringbone	Cataract.	Bone Spavin	Defective Genital Organs.	Shivering.	Stringhalt.	Defective Conformation.
Pedigree:—													
Shire... ..	950	32	3·37	9	12	5	1	4	—	—	1	—	—
Clydesdale ...	127	2	1·57	—	2	—	—	—	—	—	—	—	-
Percheron ...	49	2	4·08	1	1	—	-	—	-	-	—	—	—
Suffolk ...	149	3	2·01	—	1	-	—		1	-	1	—	—
Hackney ...	137	4	2·93	—	1	-	—	-	1	—	1	1	
Thoroughbred	162	10	6·17	1	3	—	-	1	—	1	—	4	
Arab ...	16	1	6·25	—	—	—	—	—	1	-	—	—	
Non-Pedigree:—													
Heavy ...	69	2	2·90	—		1	—	—	1	—	—	—	.
Light ...	38	2	5·26	—	—	—	—	1	—	1	—	—	—
Pony and Cob	37	1	2·70	—	—	—	1	—	—	—	—	—	—
Total Refusals	—	59	—	11	20	6	2	6	4	2	3	5	.

*   *   *   *   *   *

DECEMBER ON THE FARM.

J. R. BOND, M.B.E., M.Sc., N.D.A. (Hons.),
Agricultural Organiser for Derbyshire.

Weather Notes.—At the time of writing (mid-November) frost holds the countryside in its grip and the roads are almost impassable in the evening owing to fog. People discuss whether these are signs of a hard winter, until someone appears to settle the question by quoting an old saw such as "Ice in November to carry a hen, Nowt after Christmas but sleet, snow and rain." The unreliability of weather proverbs perhaps needs no emphasis here, but it may be recalled that the incidence of frost in November, 1923, did not ensure mild weather in January and March, 1924. As in 1923, the frost has caught a few areas of mangolds still in the open, and, the mercury having registered temperatures between 27° and 22° F. on several nights in succession, there is great likelihood that the roots will have been seriously damaged.

The main characteristic of a normal December is its wetness. In this month especially the soil is saturated with moisture and the effect of insufficient drainage becomes very apparent. At Rothamsted the quantity of water draining through 40 in. of soil averages 1,832 gallons per acre per day during December. At Craibstone the December average for the six years 1919-24 has been 2,352 gallons per acre per day.

In the midland and eastern districts of England, the temperature of the air during the greater part of the December day is below growing point (40° F.); but in the south-western area the normal mean temperature is from 40° to 45° F.; hence, while practically no growth takes place in the former parts of the country, there are other parts where late-sown corn will germinate without undue delay, winter greens and catch crops continue their growth during December, and pastures support live stock wintering out of doors with less artificial assistance than is needed elsewhere.

Young Cattle in Winter.—Little variation is found in practice as regards the summer treatment of yearling and two-year-old cattle that are intended for the dairy herd. No rack or trough food is offered until some time in the autumn. Where there is risk of husk, the younger ages of cattle may begin to receive trough food as early as the end of September; other farmers begin to supply their yearlings with concentrates about the end of October, and others rely entirely on the grass until

about the end of December. In most districts grass ceases to make new growth after about the beginning of November, except in mild seasons; and if the pastures have been grazed closely all summer, hand feeding must obviously begin earlier than is necessary where a good bite has been left for autumn consumption.

About Christmas time young cattle are either taken indoors for the remainder of the winter or they are wintered outside with the aid of fodder [illegible] of concentrates. In either ca[illegible] whether the winter ration should be liberal or plain. Wide differences of opinion and practice may be found with regard to the proper condition in which young stock should be maintained when they are intended for breeding purposes. It has sometimes been urged that the young animal, for whatever purpose intended, should be fed in such a way as will ensure rapid growth throughout the winter, the argument being that it is only the production part of a ration that yields any profit. The problem, however, is not so simple as that argument would suggest. Young cattle that have not been allowed to lay on appreciable fat during the winter make more rapid gains in the following summer and finish the season as heavy as others which have wintered on a liberal diet. The cost of the growth on summer pasture is much less than that incurred in producing a corresponding rate of increase in winter.

If cattle under 18 months old are not fed sufficiently to make a daily increase in winter of about ½ lb. they become visibly low in condition and subject to ailments, including indigestion. When gaining more than 1 lb. per day there is a tendency towards fattening, which as above indicated is not economical in cattle intended for breeding. It is not often that the home-grown bulky foods—roots, hay and straw, or pasture and fodder—will require to be supplemented with more than 2 lb. of concentrates per head per day. Whether even this quantity is necessary will depend on the progress of the cattle.

Thrice Milking.—It is generally known that most of the so-called phenomenal yields of milk are obtained with the aid of frequent milking, and many farmers have begun to wonder whether in an ordinary commercial dairy herd it would be profitable to milk three times a day. There are obvious practical difficulties connected with the third milking, which has to be performed at an hour, 7-9 p.m., when the milker is

ordinarily entitled to leisure; but the first consideration is the increase in yield which may be expected from the third operation.

Where all other factors affecting milk secretion are favourable to a high yield, milking more frequently than twice a day certainly does produce an appreciable increase. On the contrary, if a cow's yield is limited—as it often is during the first three or four months of lactation—by insufficient nutriment or restricted access to water, then [illegible] could have little effect in the direction of increased yield, without reducing the quality of the milk or accelerating the loss in condition of the animal.

Sometimes statements are made to the effect that milking three times will effect an increase in yield of half a gallon per cow per day. That may be true of a cow yielding five or more gallons per day, and while she is in full milk. The following results of actual experiments, carried out in Derbyshire during the winters of 1923-24 and 1924-25, may serve to indicate what increases may reasonably be expected from a third milking where the herd is properly rationed and watered.

In one trial, carried out by Mr. W. D. Jeffery of Belper, three newly-calved non-pedigree Shorthorn cows were milked twice a day for eight weeks after calving, then three times a day for eight weeks and afterwards as in the first period. Ignoring the first three weeks' yields, the average daily produce per cow during the three periods was as follows:—

Recording week No.	*1st period: Twice milking lb.*	*Week No.*	*2nd period: Thrice milking lb.*	*Week No.*	*3rd period: Twice milking lb.*
5	38.6	10	41.1	18	32.6
6	41.1	11	40.0	19	30.9
7	40.0	12	39.5	20	30.4
8	39.8	13	41.7	21	30.2
9	40.5	14	41.3	22	29·0
		15	35.5		
		16	35.8		
		17	35.7		
Averages	40.0		38.9		30.6

Comparing the average yields in the three periods, it would seem that if the cows had been milked only twice a day during the middle period, their daily yield would have been $(40.0 + 30.6) \div 2 = 35.3$ lb. Actually it was 38.9 lb., showing apparently an increase of 3.6 lb., or 10.2 per cent. due to the third milking.

In a second experiment, carried out by Mr. F. W. Gilbert at his Chellaston farm, eight British Friesians were used which were mostly second calvers in an advanced state of lactation. Their yields were therefore more comparable with those of the average commercial herd. After a period of twice milking the cows were milked thrice daily for nine weeks, after which twice milking was resumed. Throughout the experiment the cows were recorded at each milking, rationed according to yield and had free access to water. The average daily yields of each cow during the three periods were as follows :—

Name of Cow	*Weeks calved*	*1st period, 5 weeks. Twice milking lb.*	*2nd period, 9 weeks. Thrice milking lb.*	*3rd period, 5 weeks. Twice milking lb.*
Sweep ...	13	37.2	35.9	29.5
Bluebell ...	22	25.9	23.7	19.5
Narcissus ...	23	32.7	34.1	29.4
Madge ...	24	23.6	25.8	21.0
Dream ...	25	18.4	19.4	16.9
Chrystabel ...	26	28.2	30.2	21.3
Beta	27	28.2	28.8	24.4
Sybil	29	18.5	19.1	14.8
Averages		26.6	27.1	22.1

The increase apparent attributable to the third milking was in this case 27.1 – 24.85 = 2.75 lb. per cow per day, or 11.3 per cent.

In both experiments the fall in yield on reverting to twice milking was greater than the rise which had taken place on the change to thrice milking.

It need hardly be mentioned that, provided the cows are previously rationed correctly and have proper access to water, any increase in yield due to more frequent milking entails the consumption or utilisation of a corresponding additional quantity of food. Thus, if an increase of 10 gallons is obtained from 40 cows by milking thrice daily, their ration will require to be increased by about 35 lb. of concentrates.

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NOTES ON MANURES FOR DECEMBER.

H. V. GARNER, M.A.,
Rothamsted Experimental Station.

Manuring of Seeds.—The seeds course forms the basis of the rotation, for a good sod turned in restores a large quantity of organic matter to the soil and, particularly if much clover is present, provides a rich store of nitrogen for future crops. Every effort should therefore be made to establish a vigorous ley, and apart from cultural details much can be done by suitable manuring. In the case of clover and grass mixtures the broad principle, for the first year at any rate, is to look after the clovers and allow the grasses to look after themselves, and this may involve the addition of lime or phosphate or potash according to the nature of the soil. When the ley gets older, however, and when the clover is weak, more attention should be paid to nitrogenous dressings to make the most of the grass. On most of the stiffer soils an application of phosphate, say 2-4 cwt. of superphosphate or basic slag per acre to the nurse crop, is a sound step towards an even take of seeds. It is repeatedly noticed that if for some reason part of the barley covering seeds does not receive its phosphate dressings, the clover in that particular area is inferior to the general crop. On the lighter soils, and especially where the ley is to be mown, a dressing of potash is advisable. This application may be made to the cover crop, a useful dressing being 1 cwt. of muriate of potash or its equivalent of potash salts. If the nurse crop did not receive either potash or phosphate, it is not too late at this season to help the ley by giving the artificials to the young seeds as an autumn dressing, in the quantities suggested above. When the intention is to cut a second or third year ley for hay, a light phosphate and potash dressing is usually advisable in the previous autumn, followed by a nitrogenous application in early spring. Quantities per acre of about 2 cwt. of superphosphate, 2 cwt. of 20 per cent. potash salts, and 1 cwt. of nitrate of soda might be tried.

Dung Residues.—The comparison of the residual effects of farmyard manure made by beasts fed on roots and hay, with that of dung made by fattening animals, has been made on Little Hoos Field, Rothamsted, since 1904. Each type of manure is applied at the rate of 16 tons per acre, and after a plot has received its dressing nothing more is given until four years later when the treatment is repeated. The plots are carried through a rotation of crops. The experiment is so arranged that

the effect of the manures can be observed on each crop of the rotation, both in the year of application and as residues in the three subsequent years. The results for the period 1904-22 inclusive are given below, and are expressed as percentage increases over unmanured control plots. The figures in brackets indicate the number of experiments on which the adjacent percentages are based.

UNMANURED LAND = 100.

Manure.	Crop.	1st Year.	2nd Year.	3rd Year.	4th Year.
	Cereals.	156 (9)	149 (9)	130 (8)	124 (8)
Poor Dung.	Roots.	135 (7)	110 (5)	113 (5)	97 (4)
Rich Dung.	Cereals.	189 (9)	160 (9)	128 (8)	128 (8)
	Roots.	157 (7)	123 (5)	113 (5)	97 (4)

In the first crop taken from the manures the superiority of the rich dung is most marked, and slightly more so in the case of cereals than with roots. A small but probably definite superiority persists into the second year, but in the last two years the two types of manure are about equal in their residual effects. In the case of the corn crops a definite residue is shown in the fourth year, but this is not so for the root crops, where the action of the dung only persists till the third year.

The results bear out the farmer's high opinion of rich dung as a fertiliser, but they also show that after one crop has been taken there is not a very marked difference between the behaviour of rich dung and poor dung. Moreover, there is little doubt that the weaker action of the poor dung in its first year could be overcome by the supplementary use of quick-acting nitrogenous manures. Unfortunately, the extra nitrogen of the rich dung is very liable to losses due to faulty management, and as far as possible the aim should be to keep the dung covered and tightly packed under the stock, and to move it about as little as possible before applying it to the land.

The Response to Nitrogen.—A comparison of the yields given by various manures without nitrogen, with those produced by the same manures with nitrogen in addition, shows that over a wide range of soils the supply of nitrogen is a very important factor in crop production. A large number of field experiments carried out by public bodies in many parts of the country, where the source of nitrogen was sulphate of ammonia, have been examined from this standpoint, and the crop increases produced by such additions of sulphate of ammonia as were made, have been calculated to the basis of 1 cwt. of this fertiliser per acre.

Similar data has been derived from the recent field experiments at Rothamsted covering the period 1918-24. The experiments at Rothamsted were usually in duplicate and in some cases

in triplicate. The experiments in the counties were mostly of the single plot type. The results are as follows:—

Calculated Increases for the Addition of 1 cwt. Sulphate of Ammonia per Acre.

Crop.	County Experiments.		Rothamsted Experiments.	
	No. of Trials.	Crop Increase.	No. of Trials.	Crop Increase.
Barley grain	18	7.5 bus.	9	6.3 bus.
„ straw	16	4.0 cwt.	9	3.7 cwt.
Oats grain	51	8 8 bus.	8	8.7 bus.
„ straw	48	6.1 cwt.	8	6.6 cwt.
Potatoes	137	15.5 cwt.	19	16.4 cwt.
Mangolds	58	27.0 cwt.	—	—
Swedes	235	31.0 cwt.	10	21.0 cwt.
Meadow hay	185	5.9 cwt.	—	—
Seeds hay	80	6.5 cwt.	—	—

The figures show that the addition of nitrogen produces on the average a marked increase, which with normal prices amply covers the extra outlay (about 13s. 6d. per acre). It should be noted, however, that the crop increase called forth by the nitrogen also requires corresponding amounts of phosphate and potash for its production. It is a short-sighted policy to rely on the soil for these further amounts of plant food, as eventually the land will become exhausted by this means. This fact is well recognised by farmers, and can be illustrated from the classical fields at Rothamsted.

Crop.	Increase per 1 cwt. of Sulphate of Ammonia per acre.	
	In presence of Phosphate and Potash.	In absence of Phosphate and Potash.
Wheat Grain	4.6 bus.	1.9 bus.
(71 years) Straw	5.6 cwt.	2.2 cwt.
Barley Grain	11.4 bus.	5.9 bus.
(70 years) Straw	7.0 cwt.	3.3 cwt.
Mangolds (46 years) ...	54.0 cwt.	10.0 cwt.

On the exhausted land the sulphate of ammonia has produced very much less effect than when used on land which is maintained in phosphate and potash. It is important, therefore, to secure that the rotation shall receive addition of phosphate and potassic manures in quantities suited to the soil and the crop-

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ping, in order that the full effect of the crop-producing power of the nitrogenous fertilisers may be realised. Although the data refer to sulphate of ammonia, similar results could be expected from the use of equival[illegible]uick-acting nitrogenous manures.

Fineness of Fertilisers.—Extreme fineness is of no special importance in the case of water-soluble fertilisers such as nitrate of soda or potash salts, but the rapidity of action of the relatively insoluble manures is largely governed by their state of division. A dust-fine powder presents a much greater surface to the solvent action of the soil water than an equal weight of the same material in a gritty condition, and with the finer grade the distribution over the surface of the soil is more complete. The rapidity of action of superphosphate is due to its precipitation in the soil as dicalcium phosphate in a much more finely divided and intimately mixed condition, than could be obtained by mechanical means. The precipitated phosphate is subsequently dissolved at a quick enough rate to meet the needs of the growing crop. Basic slags are commonly ground so that about 80 per cent. of the total material will pass through a sieve having 10,000 holes to the square inch, while rock phosphates are obtainable in such a fineness whereby 80 per cent. will pass through 14,400 meshes. Much of the powder which passes these sieves is no doubt considerably finer than the meshes. In the case of bone products the advantage of availability is with the finer grades such as steamed bone flour. The state of division of limes and limestones is equally important, and where quick results are desired attention should be turned to the finely-powdered materials such as ground lime or ground limestone, which can be applied with a manure distributor and thoroughly incorporated with the top soil. In the case of lump lime, the required fineness is obtained by treating it with the proper amount of water on the farm, when a dry dusty powder (slaked lime) is produced. In order to take full advantage of their good condition, basic slags and lime should be applied in dry weather, for if broadcast on wet surfaces they tend to run together and are then difficult to mix with the soil.

* * * * * *

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are

DESCRIPTION	Week ending Nov. 18th. Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	13. 2	13. 0	12. 5	12.17	16. 7
" " Lime (N. 13 per cent.)	...	12.10	...	12.10	19. 3
Sulphate of Ammonia, neutral (N. 21.1 per cent.)	12.11*	12.11*	12.11*	12.11*	(N)11.11
Kainit (Pot. 20 per cent.)	3.10	3. 0	...	...	...
" (Pot. 14 per cent.)	3. 0	2.15	2.15	2.15	3.11
Potash Salts (Pot. 30 per cent.)	4.15	..	...	4. 9	2.11
" " (Pot. 20 per cent.)	...	...	...	3. 2	3. 1
Muriate of Potash (Pot. 50 per cent.) ...	9. 2	8. 2	8. 7	9. 2	3. 5
Sulphate of Potash (Pot. 48 per cent.) ...	11. 0	11. 5	10.10	11. 0	4. 4
Basic Slag (T.P. 34 per cent.)	...	...	3. 4§	...	...
" " (T.P. 30 per cent.)	...	...	...	2.15§	1.10
" " (T.P. 28 per cent.)	...	2.11§	...	2.10§	1. 9
" " (T.P. 26 per cent.)	...	2. 3§	...	2. 5§	1. 9
" " (T.P. 24 per cent.)	2. 9§	1.19§	1.18§		...
Superphosphate (S.P. 35 per cent.)	3. 9	...	3.14	3. 6	1.11
" (S.P. 30 per cent.)	3. 2	2.17	3. 7	3. 0	2. 0
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	8.15	8. 5	8.10	8. 5	...
Steamed Bone Flour (N. ¾, T.P. 60-65 per cent.)	6. 2†	6.15†	6. 5	5.12	...
Fish Guano (N. 6½-7, T. P. 10 per cent.) ...	...	...	...	9.15	...
Burnt Lump Lime	1. 8	1.12	1.18	2. 1	...
Ground Lime	1.15	2. 1	2. 8	1.15	...
Ground Limestone	1. 7	...	1. 4	1. 5	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

§ Prices include cost of carriage from works to town named. Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire and London prices are for not less than 4-ton lots delivered within a limited area. Cost to purchasers in other districts will be greater or less according to the distances of different purchasers from the works.

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MONTHLY NOTES ON FEEDING STUFFS.

E. T. HALNAN, M.A.,

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A New Cottonseed Cake.—The attention directed to the improvement of cotton within the Empire has resulted indirectly in the introduction on the English market of a new type of cotton cake, called by the trade Pineseed cotton cakes, or sometimes Black seed cotton cakes. The farmer is familiar with two types of common cotton cake, called Bombay cotton cake and Egyptian cotton cake. These two types have been dealt with in previous issues of this *Journal*, and there is no need to

describe them in detail. Those readers who follow these notes will already be aware that the extra "woolliness" of Bombay cotton cake is due to the fact that the "lint" or cotton fibres are adherent to the entire seed coat in Bombay seed, whereas in the Egyptian seed the lint is adherent to one end of the seed only. The result is, of course, that during the process of "ginning" considerably more fibre is left attached to the Bombay seed than to the Egyptian seed, with the result that the Bombay cake is more fibrous than the Egyptian cake.

The new cakes that have been introduced on the market are derived from Black cottonseed grown in India, and crushed in this country. The lint obtained from this seed is said to be superior in quality to the ordinary Bombay cottonseed, which seed it will probably gradually displace. As the imports of Black cottonseed increase, the imports of ordinary Bombay seed will probably decrease, so that the new type of cotton cake will become available in gradually increasing quantities. Examination of the seed of the three types reveals the fact that the new type of seed has a little more lint adhering to it than the Egyptian seed, but considerably less than the Bombay seed. It would be expected, therefore, that the Black Indian cottonseed cake would occupy a position somewhat approaching Egyptian cotton cake in character, and examination of the resultant cakes shows this to be the case. The trade analyses gives the following representative figures:—

Cake.		*Oil Percentage.*	*Albuminoids Percentage.*	*Carbohydrates Percentage.*
Bombay	...	5	19	37
Black seed	...	5	22	36
Egyptian	...	5	23	34

A good sample of Egyptian cake is dark greeny-brown and shows very little lint when the cake is fractured. A sample of Bombay cake, on the other hand, is a lighter brown and shows abundance of lint when broken. A good sample of the Black cottonseed cake is somewhat greener than the Egyptian cake, and shows slightly more lint when broken than the Egyptian cake. This difference, however, is only detectable when the two cakes are compared side by side, and there is little doubt that the casual buyer could easily confuse the two. The appearance of the cakes, and the analyses both indicate that the Black cottonseed cake is approximate in feeding value to Egyptian cotton cake, and where purchases can be made at prices slightly less than the Egyptian cake, the new type of cake should prove more economical.

Description.	Price per Qr. s. d.	lb.	Price per Ton. £ s	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	§ Starch Equiv. per 100 lb.	Price per Unit Starch Equiv. s.	Price per lb. Starch Equiv. d.	§ Protein Equiv. %
Wheat, British	—	—	11 12	0 15	10 17	72	3/0	1·61	9·6
Barley, British Feeding	—	—	9 0	0 11	8 9	71	2/5	1·29	6·2
,, Canadian :— No. 4 Western	31/3	400	8 15	0 11	8 4	71	2/4	1·25	6·2
,, American	30/9	,,	8 12	0 11	8 1	71	2/3	1·20	6·2
,, Russian	29/6	,,	8 5	0 11	7 14	71	2/2	1·16	6·2
Oats, English, White	—	—	9 5	0 13	8 12	60	2/10	1·52	7·6
,, ,, Black and Grey	—	—	8 15	0 13	8 2	60	2/8	1·43	7·6
,, Scotch, White	—	—	9 17	0 13	9 4	60	3/1	1·65	7·6
,, Irish. Black	—	—	8 10	0 13	7 17	60	2/7	1·38	7·6
,, Canadian :— No. 3 Western	29/6	320	10 7	0 13	9 14	60	3/3	1·74	7·6
,, American	26/3	,,	9 3	0 13	8 10	60	2/10	1·52	7·6
,, Argentine	27/6	,,	9 12	0 13	8 19	60	3/0	1 61	7·6
,, Chilian	26/0	,,	9 2*	0 13	8 9	60	2/10	1·52	7·6
Maize, Argentine	38/9	480	9 0	0 12	8 8	81	2/1	1·12	6·8
,, South African	36/3	,,	8 8*	0 12	7 16	81	1/11	1·03	6·8
Beans, English Winter	—	—	10 0†	1 10	8 10	66	2/7	1·38	20·0
,, Chinese	—	—	11 2*	1 10	9 12	66	2/11	1·56	20·0
Peas, Japanese	—	—	32 15*	1 6	31 9	69	9/1	4·86	18·0
Dari, Egyptian	—	—	12 10	0 14	11 16	74	3/2	1·70	7·2
Rye, Home-grown	—	—	8 0	0 14	7 6	72	2/0	1·07	9·1
Millers' Offals :— Bran, British	—	—	7 0	1 5	5 15	42	2/9	1·47	10·0
,, Broad	—	—	8 10	1 5	7 5	42	3/5	1·83	10.0
Middlings— Fine Imported	—	—	9 2	1 0	8 2	69	2/4	1·25	12·0
Coarse, British	—	—	8 0	1 0	7 0	58	2/5	1·29	11·0
Pollards, Imported	—	—	6 17	1 5	5 12	60	1/10	0·98	11·0
Meal, Barley	—	—	10 0	0 11	9 9	71	2/8	1·43	6·2
,, Maize	—	—	10 0	0 12	9 8	81	2/4	1·25	6·8
,, ,, South African	—	—	8 15	0 12	8 3	81	2 0	1·07	6·8
,, ,, Germ	—	—	9 5	0 18	8 7	85	2/0	1·07	10·0
,, ,, Gluten Feed	—	—	9 15	1 5	8 10	76	2 3	1·20	19·0
,, Locust Bean	—	—	9 12	0 9	9 3	71	2/7	1·38	3·6
,, Bean	—	—	12 5	1 10	10 15	66	3/3	1·74	20·0
,, Fish	—	—	20 0	3 19	16 1	53	6/1	3·26	48·0
Linseed	—	—	20 5	1 9	18 16	119	3/2	1·70	19·0
Linseed Cake, English 12% Oil	—	—	13 10	1 15	11 15	74	3/2	1·70	25·0
,, ,, 10% Oil	—	—	12 15	1 15	11 0	74	3/0	1·61	25·0
,, ,, 9% Oil	—	—	12 10	1 15	10 15	74	2/11	1·56	25·0
Soya Bean ,, 6% Oil	—	—	12 0	2 10	9 10	69	2/9	1·47	36·0
Cottonseed Cake, English 5¼% Oil	—	—	7 15	1 12	6 3	42	2/11	1·56	17·0
,, ,, Egyptian 5¼% Oil	—	—	7 10	1 12	5 18	42	2/10	1·52	17·0
Decorticated Cotton-seed Meal 7% Oil	—	—	10 17	2 10	8 7	74	2/3	1·20	35·0
Coconut Cake 6% Oil	—	—	9 12	1 9	8 3	79	2/1	1·12	16·0
Ground Nut Cake 7% Oil	—	—	9 10†	1 14	7 16	57	2/9	1·47	27.0
Palm Kernel Cake 6% Oil	—								
,, ,, ,, Meal		—	8 15	1 1	7 14	75	2/1	1·12	17·0
6% Oil	—	—	8 0‖	1 1	6 19	75	1/10	0·98	17·0
,, ,, Meal 2% Oil	—	—	8 7†	1 2	7 5	71	2/1	1·12	17·0
Feeding Treacle	—	—	7 2	0 9	6 13	51	2/7	1·38	2·7
Brewers' Grains :— Dried Ale	—	—	8 7	1 2	7 5	49	3/0	1·61	13·0
,, Porter	—	—	7 17	1 2	6 15	49	2/9	1·47	13·0
Wet Ale	—	—	1 6	0 8	0 18	15	1/2	0·62	4·8
,, Porter	—	—	1 1	0 8	0 13	15	–/10	0.45	4·8
Malt Culms, Porter	—	—	7 5†	1 12	5 13	43	2/8	1·43	16·0

* At Liverpool. † At Bristol. ‖ At Hull.

§ The figures in these columns have been corrected in accordance with the tables given in the Report of the Committee on the Rationing of Dairy Cows.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of October and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 1s. per ton. The food value per ton is therefore £8 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 5d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·29d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices:—N, 11s. 10d.; P_2O_5, 2s. 8d.; K_2O, 2s. 11d.

The Composition of Poultry Mixtures.—A valuable contribution to our knowledge on the value of mixed poultry grains, offered for sale by dealers in poultry foods, has recently appeared in the *Scottish Journal of Agriculture.** Professor Linton subjected to critical survey 50 samples of mixed grains sold as "chicken food," and 37 samples of "poultry mixed grains." These samples were drawn from actual samples on sale in various localities in England, Scotland, Wales and Ireland, and can therefore be regarded as representative. From the results of these investigations several important facts emerge.

The first is that there appears to be no settled agreement among poultry food vendors as to the combination of grains calculated to give the best results with regard to the chicken foods. The number of different seeds present in mixtures varied from 2 to 10, the average number being 6. Twelve of the samples showed grit present to more than two per cent., one sample actually containing as much as 16 per cent. of grit. No less than 24 per cent. of the samples were compounded of grains of inferior quality. The first 8 grains chiefly present in order of frequency were maize, wheat, pinhead oatmeal or groats, millet, dari, canary seed, rice and buckwheat. With regard to the poultry mixed grains, there appeared to be a better concensus of opinion as to the best combination of grains suitable for poultry feeding. The most frequent combination of grains was maize, oats, barley and dari. Ten samples of the 37 consisted of good quality grains, and there were no fewer than 12 samples composed of musty and inferior grains. Three of the samples contained high percentages of grit, namely, 13, 17 and 32.5.

The results of the examination showed that whereas there are at present on the market some first grade poultry mixtures, there are in addition a large number of inferior ones, and the need exists for would-be purchasers to exercise extreme vigilance when purchasing poultry mixtures, and to deal only with those firms whose products can be regarded as above suspicion.

* The Composition of Poultry "Mixed Grains": R. G. Linton, *The Scottish Journal of Agriculture*, Vol. VIII, No. 4. Oct., 1925.

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follows:—

	Starch Equivalent.	Protein Equivalent.	Per Ton. £ s.
Barley (Imported)	71	6.2	8 10
Maize	81	6.8	9 0
Decorticated Ground Nut Cake ...	73	41.0	12 15
„ Cotton Cake ...	71	34.0	12 15

Add 10s. per ton, in each case, for carriage. The cost per unit starch equivalent works out at 2.19 shillings, and per unit protein equivalent, 2.86 shillings.

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The " food values " which it is recommended in the Report of the Committee on Rationing Dairy Cows should be applied by Agricultural Organisers and other advisers in connection with advisory schemes on the rationing of dairy cows, are given in the November issue of the Ministry's *Journal.*)

FARM VALUES.

CROPS.	Starch Equivalent.	Protein Equivalent.	Food Value per Ton, on Farm.
	Per cent.	Per cent.	£ s.
Wheat	72	9·6	9 5
Oats	60	7·6	7 13
Barley	71	6·2	8 13
Potatoes	18	0·6	2 1
Swedes	7	0·7	0 17
Mangolds	7	0·4	0 16
Beans	66	20	10 1
Good Meadow Hay	31	4·6	4 1
Good Oat Straw	17	0·9	2 0
Good Clover Hay	32	7·0	4 10
Vetch and Oat Silage	13	1·6	1 13
Barley Straw	19	0·7	2 3
Wheat Straw	11	0·1	1 4
Bean Straw	19	1·7	2 6

* * * * * *

AGRICULTURAL RETURNS OF ENGLAND AND WALES.

PRODUCE OF CROPS.

PRELIMINARY Statement showing the Estimated Total Produce and Yield per Acre of the Corn and Hay Crops in England and Wales in 1925, with Comparisons for 1924, and the Average Yield per Acre of the Ten Years 1915-24.

Crops.		Estimated Total Produce. 1925.	Estimated Total Produce. 1924.	Acreage. 1925.	Acreage. 1924.	Estimated Yield per Acre. —	Estimated Yield per Acre. 1925	Estimated Yield per Acre. 1924.	Average of the Ten Years 1915-24.
				Acres.	*Acres.*				
Wheat -	- Tons	1,360,000	1,363,000	1,499,222	1,544,764	Cwt.	18·1	17·6	17·1
	Qrs.	*6,166,000*	*6,220,000*			*Bush.*	*32·9*	*32·2*	*31·0*
Barley -	- Tons	1,010,000	1,014,000	1,317,418	1,314,026	Cwt.	15·3	15·4	14·6
	Qrs.	*5,297,000*	*5,297,000*			*Bush.*	*32·2*	*32·2*	*30·5*
Oats -	- Tons	1,380,000	1,499,000	1,867,591	2,037,097	Cwt.	14·8	14·7	13·4
	Qrs.	*9,917,000*	*10,526,000*			*Bush.*	*42·5*	*41·3*	*38·5*
Mixed Corn -	Tons	94,000	96,000	123,370	133,698	Cwt.	15·2	14·5	—
	Qrs.	*569,000*	*566,000*			*Bush.*	*36·9*	*33·9*	—
Beans -	- Tons	159,000	187,000	179,229	227,607	Cwt.	17·7	16·4	15·1
	Qrs.	*695,000*	*821,000*			*Bush.*	*31·0*	*28·8*	*27,0*
Peas -	- Tons	64,000	80,000	88,339	108,362	Cwt.	14·6	14·8	13·6
	Qrs.	*290,000*	*358,000*			*Bush.*	*26·2*	*26·4*	*24·4*
Seeds Hay* -	Tons	2,562,000	2,787,000	1,721,988	1,752,036	Cwt.	29·8	31·8	28·5
Meadow Hay†	Tons	4,547,000	5,212,000	4,811,637	4,501,448	Cwt.	21·1	23·2	20·8

* Hay from Clover, Sainfoin, and Grasses under rotation. † Hay from Permanent Grass.

NOTE.

The corn crops of this year are threshing out better than was anticipated, and the detailed estimates now available consequently show increases over previous forecasts. Yields per acre are above average in the case of each crop. Winter corn is of good quality, but much of the spring barley is inferior and really good malting barley is scarce. The showery weather throughout harvest caused much of the corn to be carted in damp condition.

The yield per acre of Wheat is estimated at 18.1 cwt. or half a cwt. more than last year and 1 cwt. above the average of the ten years 1915-24. Yields are above average in each division of the country, comparatively few counties obtaining poorer yields than usual. The estimated total production of 1,360,000 tons is practically the same as in 1924 in spite of the reduction of 45,000 acres in the area grown. Both the acreage and yield per acre of Barley are little different from last year so that the estimated total production of this crop, 1,010,000 tons, is also about the same as in 1924. The estimated yield per acre of 15.3 cwt. is nearly three-fourths of a cwt. above

average. Yields varied a good deal in different counties, but Norfolk. Lincoln and Suffolk, the most important counties for this [illegible] obtained better y[illegible]
The estimated total pro[illegible] about 120,000 tons less than last year, when, however, the acreage was greater by 170,000 acres. The yield per acre is estimated at 14.8 cwt. or nearly 1½ cwt. above average, and practically the same as last year. Well over average yields were obtained in each division of England, only a few counties having rather lighter crops than usual, but the yield in Wales was little above its decennial mean. Mixed Corn is estimated at an average yield per acre of 15.2 cwt. and the total production at 94,000 tons or very slightly less than in 1924. Beans yielded well and the estimated yield per acre of 17.7 cwt. is 2¼ cwt. above average. Exceptionally heavy crops were obtained in some of the eastern counties. The total production of 159,000 tons is, however, some 28,000 tons less than last year owing to a sharp reduction in area. The total production of Peas, 64,000 tons, is also much smaller than last year from the same cause, the estimated yield per acre of 14.6 cwt. being only one-fourth of a cwt. lower than in 1924 and 1 cwt. above average.

The yields per acre and the total production of corn are given in the table both in terms of weight and of measure. When further information is received as to the natural weight of grain of this year's crop the figures may require revision.

The weather during May was favourable for the growth of hay, but owing to the dry spell in June meadows did not fill up well with bottom grass. The crops were secured in very good condition and the quality is excellent as a rule. The yield per acre of Seeds Hay is estimated at 29.8 cwt., or 1¼ cwt. above average, but 2 cwt. lighter than the heavy crop of last year. Most eastern and south-eastern counties had very good crops, and in the south-west yields were generally well above average, but in the north and in Wales many counties had lighter crops than usual. The estimated total production of 2,562,000 tons is 225,000 tons less than last year. Yields of Meadow Hay were relatively not so good as those of seeds hay, the estimated average yield per acre of 21.1 cwt. being only one-fourth of a cwt. above average. As compared with 1924 the yield per acre is lighter by about 2 cwt. per acre, and the total production, viz., 4,547,000 tons, is smaller by 665,000 tons. As in the case of seeds hay the best results were in the

east, and crops wer[illegible] h and in Wales. Taking both k[illegible] [illegible]ction is estimated at 7,109,000 tons against 7,999,000 tons in 1924 and 7,707,000 tons in 1923.

The estimate of the Hop Crop* was issued on 19th October. The estimates of the potato and root crops will be issued about the end of November.

* * * * * *

MISCELLANEOUS NOTES.

Ground Rock Phosphate.

IN recent years a good deal of attention has been given to the possibility of substituting ground rock phosphate as a fertiliser for basic slag. Experiments have shown that on many types of grassland the effects of ground phosphate are comparable with those of basic slag though the immediate action may be slower. Since a larger quantity of phosphoric acid, the essential fertilising principle, can be bought for the same money in ground phosphate than in basic slag, it becomes a question for the farmer whether he prefers the slower but more enduring effect of rock phosphate to the quicker action of basic slag or especially of superphosphate.

It is generally found that ground rock phosphate is most effective in soils of high organic content, because the acids in this type of soil exert a solvent influence on the phosphate. Ground phosphate is therefore most likely to answer on old grassland, particularly old clay pastures which are naturally poor in phosphoric acid but which have accumulated much organic matter and are naturally wet. Soils with a low phosphoric acid content will respond to an application of ground rock phosphate provided, as in all cases, it is applied liberally and in a finely ground condition. The fineness of grinding is undoubtedly a very important factor as regards the availability of this material to crops. The main advantage of a finely ground material is that it offers a much larger surface on which the dissolving influences of soil water can operate than where the phosphate is in relatively coarse particles. The bulk of the ground rock phosphate sold in this country is believed to be of the fineness usually guaranteed with basic slag, that is that 80 per cent. will pass through a sieve having 10,000 meshes per square inch. Some grinders, however, produce an article 80 per cent. of which is guaranteed to pass through a sieve

* See this *Journal*, November, 1925, p. 760.

having 11,400 meshes per square in[illegible] doubt be more available in the soil, but the question of the increased cost of the finer grinding has to be considered.

The desirability of using a relatively insoluble phosphate, such as we have in ground rock phosphate, is a problem which should be considered by each farmer. It is a question affected by many factors, the principal of which are (1) the relative unit price of the material delivered to the farm as compared with that of other phosphatic fertilisers; (2) the nature of the soil and of the climate.

It would be misleading to estimate the total quantity of ground rock phosphate used in this country on the basis of the quantity which is actually ground and delivered by British makers, as it is understood that large quantities are imported from abroad. Inquiries recently made by the Ministry indicate however that there is a considerable expansion of the home demand, particularly in certain districts.

The prices charged for home deliveries vary from £2 12s. 6d. to £3 15s. per ton free on rail, according to quality. The "Unit Price," which is so valuable a guide in comparing the relative costs of the various kinds of phosphatic fertilisers, works out on an average at about 1s. This compares with the current unit price of 2s. (f.o.r. London) for superphosphate (30 per cent. soluble phosphate), or 1s. 10d. (including cost from works to London) for basic slag (30 per cent. total phosphate).

It is proposed to publish from time to time the current market price of ground rock phosphate, in "The Agricultural Market Report" (published each week by the Ministry, price 2d. net, or post free for three months, 2s. 6d.) and the Ministry will be glad to give the names and addresses of the nearest merchants, who are understood to be in a position to supply this material, to any farmer who is unable to secure supplies from the merchant from whom he generally obtains his fertilisers.

Enfranchisement of Copyhold Lands, etc.

LORDS and Stewards of Manors and other persons who will be affected by the statutory enfranchisement of copyhold lands on the 1st January next by reason of the Law of Property Act, 1922, which comes into force on that date, will be interested to learn of the recent publication by the Ministry of Agriculture and Fisheries of the Manorial Incidents

(Extinguishment) Rules, 1925 (copies obtainable from His Majesty's Stationery Office). The Rules set forth the provisions of the Copyhold Act, 1894, as modified and applied by Part VI of the Law of Property Act, 1922, and deal mainly with the procedure for the compulsory extinguishment of manorial incidents.

It will be remembered that the extinguishment of such manorial incidents as are saved by this Act can be carried out either by (1) agreement between the lord of the manor and copyhold tenant, or (2) by the service of a notice requiring the ascertainment of the compensation for the extinguishment. In the event of no action being taken under (1) or (2) above, the remaining manorial incidents will become extinguished in the ordinary course at the end of ten years from the 1st January, 1926. In the meantime, and until the extinguishment of such manorial incidents, it will be necessary for all legal instruments for the transfer of enfranchised land or of any interest in such land to be produced to the steward of the manor for endorsement within six months of the date of the instrument. The form and manner of certificate to be so endorsed is prescribed in the Ministry's Enfranchised Land (Certificate of Endorsement) Regulations, 1925. Other publications of the Ministry in connection with the changes in the law of real property which will come into effect on the 1st January next are the Redemption of Rents Rules, 1925, and the Renewable Leaseholds Regulations, 1925.

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Clean Milk Course for Sanitary Inspectors.

IN the October issue of this *Journal* reference was made to a course of instruction in Clean Milk Production which had been provided for Sanitary Inspectors by the Agricultural Department of Leeds University, and it is now possible to record that as a result of the success of the course, those concerned with the administration of Milk Regulations within the area served by that Department have been so impressed with the usefulness of the work, that they have prevailed with the University to provide courses of a similar nature to be held in the evenings during the current winter to extend over a period of ten weeks. Already a sufficient number of applications for admission has been received to justify the holding of the first of such courses.

It is understood that several of the other provincial Agricultural Colleges are about to institute courses similar to that held at Leeds, and the interest which is being taken in this matter suggests that they will be equally successful and so lead to further useful developments.

* * * * * *

The Egg and Chick Distribution Scheme.

THE results of the Scheme in England during the 1925 season have been entirely satisfactory, the distribution and cost, compared with the year 1924, being as follows:—

Year.	*Stations.*	*Eggs.*	*Chicks.*	*Duck Eggs.*	*Ducks.*
1924	227	6,034 doz.	3,139 doz.	263 doz.	51 doz.
1925	267	6,921 ,,	3,705 ,,	150 ,,	119 ,,

Year.	*Subsidies.*	*Printing, etc.*	*Total.*
1924	£995 5 2½	£276 17 5	£1,272 2 7½
1925	£1,151 1 3	£287 11 11	£1,438 13 2

The increased distribution is partly accounted for by the fact that 30 counties adopted the Scheme compared with 26 in 1924, but is mainly attributable to the wide advertisement of the Scheme obtained through broadcast talks from the British Broadcasting Company's stations. A short lecture given by one of the Ministry's Inspectors from the Birmingham station in March last resulted in the Warwickshire and Worcestershire Education Authorities receiving a great number of inquiries from prospective purchasers in their respective areas.

Of the total of 267 stations established in 1925, 131 were trapnested and it is estimated that 60 per cent. of the total stock distributed came from trapnested stock.

Five counties established none but trapnested stations. Only two counties (Lindsey and West Sussex) established all non-trapped stations, but the Authorities concerned have since decided to urge their station-holders to trapnest in future. Four counties operated non-subsidised schemes and all except one showed improved sales compared with the previous year. Wiltshire, which has a non-subsidised scheme, charges each station-holder a registration fee of 5s. and the total amount collected in this way goes towards the cost of the scheme in printing and advertising. The results of the scheme operated in Wales are not yet to hand.

The Distribution Scheme will again be in operation in most counties in England and Wales during the coming 1926 season. Its object is to provide facilities whereby small holders and others engaged in poultry keeping in a small way may obtain stock of good productive capacity from approved breeders in their district. Details of the Scheme are given in the Ministry's Leaflet No. 389, obtainable on application to the Secretary of the Ministry, 10, Whitehall Place, London, S.W.1.

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Poultry Instructors' Conference.

THE Fourth Annual Conference of County and College Poultry Instructors was held at the Ministry on 21st October. About 70 instructors, agricultural organisers, college principals, etc., were present, including representatives from Scotland and Wales. Addresses were given by Captain F. M. Doyle, M.R.C.V.S., of the Ministry's Veterinary Laboratory, on "The Relation of County Poultry Instructional Work to Research in Poultry Diseases"; by Professor Willard C. Thompson, B.Sc. (Agric.), on "The Progress and Aims of the National Institute of Poultry Husbandry," of which he is Director; and by Mr. J. P. Harding, a well-known general farmer from Dorset, on "The Economic Management and Housing of Poultry on the General Farm." All the addresses were followed by open discussion. An address by Mr. Ambrose Keevil, O.B.E., M.C., a member of one of the largest firms of egg wholesalers in the country, on "Problems in the Marketing of Home-Produced Eggs" aroused much interest. The speaker deplored the fact that during the first nine months of this year eggs in shell to the value of £11,330,924 were imported into Great Britain and Northern Ireland, *i.e.*, the country was paying £314,714 a week for eggs which might easily be produced at home. He instanced the example of Belgium, which, although practically destitute of poultry at the termination of the war, had been able to export this year about £3,000,000 worth of eggs.

Other subjects of technical interest were also dealt with at the Conference, which was voted a great success, and undoubtedly fulfilled its object of stimulating and co-ordinating the work of the instructors.

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Export of Breeding Stock.

NUMBER and Declared Value of Animals Living, for Breeding, Exported from Great Britain and Northern Ireland in the three months ended September, 1925, compared with the corresponding period in 1924 :—

(From Returns supplied by H.M. Customs and Excise.)

Country to which Exported	July to Sept., 1925		July to Sept., 1924	
	Number	Declared Value	Number	Declared Value
CATTLE		£		£
Argentina	95	18,152	10	7,605
Brazil	12	1,982	1	520
Denmark	1	275	0	0
France	20	349	0	0
Germany	23	794	0	0
Uruguay	1	260	21	8,225
British India	8	295	0	0
Irish Free State	1,194	14,421	1,569	18,947
Kenya Colony	0	0	11	1,234
Union of South Africa ...	17	2,867	0	0
Other Countries	2	55	8	410
Total of Cattle	1,373	39,453	1,653	36,941
SHEEP AND LAMBS				
Argentina	197	4,678	281	7,071
Chile	3	235	4	120
Germany	3	111	30	1,179
Russia	205	3,454	0	0
Uruguay	13	195	1	20
Australia	4	116	0	0
Falkland Isles	20	730	0	0
Irish Free State	1,543	4,426	3,730	10,888
Other Countries	13	331	1	9
Total of Sheep and Lambs	2,001	14,279	4,047	19,287
SWINE				
Austria	0	0	771	8,060
Brazil	6	242	0	0
Czecho-Slovakia	0	0	54	1,450
France	0	0	28	414
Germany	0	0	19	508
Japan	6	275	0	0
Russia	31	1,088	0	0
Switzerland	0	0	8	400
Irish Free State	209	802	339	678
Union of South Africa ...	21	515	0	0
Other Countries	20	403	17	427
Total of Swine	293	3,325	1,286	11,932

The Agricultural Index Number.

AGRICULTURAL produce generally realised lower prices in October than in the previous month, and the index number in consequence declined 4 points, the general level of prices being 53 per cent. higher than in the corresponding month of 1911-13. This is the lowest figure recorded in 1925 with the exception of July when prices averaged 51 per cent. above pre-war. In October last year the index number was 63 per cent. higher than in the basic years, or 10 points higher than in the month under review. The reduction in potato prices from the extremely high level of October last year is responsible for 5 points of the decline, while the decrease in the prices of wheat and barley as compared with last autumn are also equivalent to a drop of 5 points in the general index number.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.	1925
January ...	200	183	75	68	61	70
February ...	195	167	79	63	61	67
March ...	189	150	77	59	57	65
April ...	202	149	70	54	53	58
May ...	180	119	71	54	56	57
June ...	175	112	68	51	58	55
July ...	186	112	72	53	52	51
August ...	193	131	67	54	59	56
September	202	116	57	56	60	57
October ...	194	86	59	51	63	53
November	193	79	62	53	64	—
December	184	76	59	56	63	—

Average prices for all cereals were lower on the month, especially for wheat and barley, the former averaging 10s. 5d. and the latter 12s. 3d. per cwt. or reductions of 1s. 1d. and 1s. 10d. per cwt. respectively, while oats at 9s. 2d. per cwt. were 6d. per cwt. cheaper than in September. The index number for barley fell 25 points, while wheat and oats declined by 13 and 10 points respectively on the month. All cereals sold at much lower prices than in the corresponding month of last year, but, as compared with October, 1923, wheat and barley were dearer by about 15 per cent. and oats by 5 per cent.

Fat cattle and sheep were cheaper than in September, and the index figures declined by 5 and 7 points respectively. Pigs, on the other hand, continued to advance, the index number for bacon pigs rising to 70 and for porkers to 71 per cent. above the basic years. As compared with October, 1924, fat cattle

sold at the same price, while sheep were about 15 per cent. cheaper and pigs approximately 20 per cent. dearer. Prices of sheep are now lower than for nearly four years, but pigs are again making good prices after the recent slump.

Dairy cattle averaged nearly £1 per head more than in September, but as an increase was recorded in the base years the index number has only advanced 2 points. Store cattle and store sheep continued to decline in value, but store pigs again sold at higher prices. Store cattle were relatively cheap at 32 per cent. above pre-war cost, while store sheep and pigs were comparatively dear at 69 and 88 per cent. above.

Winter milk prices came into operation on 1st October, and the average price of milk delivered under contract into London, Birmingham and Manchester, was 1s. 5⅜d. per gallon as against 1s. 0¼d. for the previous month. The winter milk prices are now on a relatively higher scale as compared with the summer prices than in pre-war years, and the index number in consequence has advanced to 74 per cent. above the base years, this figure being 7 points lower than that of a year ago, but practically the same as in October, 1923. Butter and cheese were dearer than in September, but as the increases recorded were practically proportionate to those of the base years, the index figure for cheese was unchanged at 77 per cent. above pre-war, while butter was only 1 point higher at 71 per cent. above. Eggs were much dearer, and, as the increase was proportionately greater than in pre-war years, the index number shows a rise of 15 points. Butter and eggs sold at practically the same price as a year ago, while cheese was about 25 per cent. dearer.

Potatoes have averaged £5 10s. per ton as compared with £5 13s. for September, but, as a reduction in price occurred in the base years, the index number was unchanged at 53 per cent. above pre-war level. Potatoes were about 40 per cent. cheaper than a year ago and 5 per cent. cheaper than in October, 1923. Hay was practically unchanged in value and was only slightly dearer than in the corresponding month of 1911-13.

The index number for fruit fell sharply. This was accounted for to a large extent by the omission of plums which were very dear this season, but apples recorded a fall of 25 points and pears one of 47 points. The average level of fruit prices was only about 55 per cent. above the base years as compared with 115 per cent. above in September. With the exception

of cabbage all vegetables declined in price and as Brussels sprouts and onions, which sold at comparatively low prices, are included in the October index figure, a reduction of 21 points is recorded on the month. On the average vegetables were rather less than 50 per cent. above pre-war prices, Brussels sprouts, cabbage, and cauliflowers being 16, 42 and 71 per cent. above, while carrots were 69, celery 58 and onions 35 per cent. above 1911-13.

* * * * * *

Farm Workers' Minimum Wages.

MEETINGS of the Agricultural Wages Board were held on the 19th October and 12th November, at 7, Whitehall Place, S.W.1, the Chairman, Lord Kenyon, presiding.

The Board considered notifications from Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and proceeded to make the following Orders carrying out the Committees' decisions:—

Cambridgeshire and Isle of Ely.—An Order fixing minimum and overtime rates of wages for male and female workers to operate as from the 1st Nov. (when the current rates expire) up to the 31st Oct., 1926. The new Order provides for the continuance, with minor alterations, of the existing rates, the rate in the case of male workers of 21 years of age and over employed as horsemen, cowmen or shepherds being 37s. per wk. for the hours necessary for the performance of the customary duties, and in the case of other male workers 30s. per wk. of 51 hr. in summer and 48 hr. in winter, with overtime at 9d. per hr. on week-days and 11d. per hr. on Sundays. In the case of female workers of 18 years of age and over the minimum rate is 5½d. per hr., with overtime at 7d. per hr.

Cheshire.—An Order to operate from the 1st Nov. continuing the present minimum and overtime rates of wages for male workers and minimum rates of wages for female workers until the 31st Oct., 1926. The rates in the case of male workers of 21 years of age and over are 35s. per wk. of 54 hr., with overtime at 9d. per hr., and in the case of female workers of 18 years of age and over 6d. per hr., with a proviso that in the case of female workers engaged for milking the sum payable in respect of each "meal" (*i.e.*, each occasion on which the worker visits her place of employment for the purpose of milking) shall be not less than 6d.

Essex.—An Order continuing the existing minimum and overtime rates of wages for male and female workers to come into force on the 1st Nov. (when the existing rates are due to expire) and to continue in force until the 28th Feb., 1926. The rates in the

case of male workers aged 21 years and over are 30s. per wk. of 50 hr. in summer and 48 hr. in winter, with overtime at 9d. per hr., and in the case of female workers of 21 years of age and over 5d. per hr., with overtime at 6d. per hr.

Hampshire.--An Order fixing minimum and overtime rates of wages for male workers and minimum rates for female workers to come into operation on the 29th Nov. (when the current rates are due to expire) and to continue up to the 11th Oct., 1926. The new order continues the minimum rates of male workers unchanged, the rate in the case of workers aged 21 and over being 30s. per wk. of 51 hr. in summer (first Monday in March to first Sunday in Nov.) and 48 hr. in winter (remainder of the year). The overtime rates for male workers are increased by ½d. per hr., except in the case of employment in attendance on animals for which the present overtime rates continue to apply. The new overtime rate in the case of male workers aged 21 and over is 8d. per hr. The minimum rate for female workers of 18 years of age and over is 5d. per hr. No overtime rates are fixed in the case of female workers.

Lincolnshire (parts of Holland).—An Order fixing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers to come into operation on the 1st Nov. (when the existing rates are due to expire) and to continue in force until 30th Oct., 1926. The rate in the case of ordinary male workers of 21 years of age and over is 35s. per wk. of 50 hr. in summer and 48 hr. in winter (instead of 36s. per wk. of 52 hr in summer as at present). Cattlemen receive an additional 6s. per wk. to cover all employment in excess of 50 hr. in summer and 48 hr. in winter, except employment which is treated as overtime employment. In the case of shepherds similar rates obtain, with special payments during the lambing season, whilst for horsemen the additional weekly sum is 10s. The overtime rates for male workers of 21 years of age and over are 9d. per hr. on days other than Saturday and Sunday, 10½d. per hr. on Saturday, and 1s. 1½d. per hr. on Sunday. The minimum rate for female workers of 15 years of age and over is 6d. per hr.

Northamptonshire and Soke of Peterborough.—An Order continuing the existing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers to come into force on the 26th Oct. (when the existing rates expire) and to continue in force until 25th Oct., 1926. The minimum rates are, in the case of male workers of 21 years of age and over, 30s. per wk. of 50 hr. in summer and 48 hr. in winter, with overtime at 9d. per hr. on week-days and 11d. per hr. on Sundays, and in the case of female workers of 18 years of age and over 6d. per hr. for all time worked.

Shropshire.—An Order to come into operation on the 23rd Nov. increasing the overtime rates for all classes of male workers, the overtime rate in the case of male workers of 21 years of age and over being increased from 8d. to 9d. per hr. for all overtime employment. In the case of female workers the rates remain unchanged, the rate for those of 18 and over being 6d. per hr. The new Order also provides that for employment of male

workers aged 21 years and over on the hay and corn harvests the overtime rate shall be not less than 10d. per hr.

Sussex.—An Order fixing minimum and overtime rates of wages for male and female workers to come into operation on the 26th Oct. (when the existing rates are due to expire) and to continue in force until the 31st Oct., 1926. The minimum rate for male workers of 21 years of age and over is 31s. per wk. of 52 hr. in summer and 48 hr. in winter (instead of 30s. as at present), overtime being payable at 9d. per hr. on week-days and 10½d. per hr. on Sundays. In the case of female workers of 18 years of age and over the minimum rate is 5d. per hr., with overtime at 6¼d. per hr. on week-days and 7½d. per hr. on Sundays.

Warwickshire.—An Order continuing the existing minimum and overtime rates of wages for male workers and fixing reduced rates for female workers to come into operation on the 1st Nov. (when the existing rates are due to expire) and to continue in force until the 30th Oct., 1926. The minimum rate in the case of male workers of 21 years of age and over is 30s. per wk. of 50 hr. in summer and 48 hr. in winter, with overtime at 9d. per hr. on week-days and 11d. per hr. on Sundays. The new rate for female workers aged 18 years and over is 5d. per hr. (the existing rate being 5½d. per hr. for all workers from 16 years upwards).

East Riding of Yorkshire.—An Order to operate as from the 24th Nov. fixing minimum and overtime rates of wages for male and female workers up to the 23rd Nov., 1926. The rate in the case of male workers aged 21 years and over who are not boarded and lodged by their employers is increased from 34s. to 35s. for a wk. of 52½ hr. in summer (first Monday in March to last Saturday in October) and of 48 hr. in winter (remainder of the year), with an increase of 1s. per wk. for every 10 points that the "cost of living" index figure rises above the figure of Dec., 1924. In the case of workers who are boarded and lodged by their employers the rates are: foremen, 32s.; beastmen and shepherds, 29s.; waggoner, 28s.; and lesser rates for lads, in each case to cover a wk. of 52½ hr. in summer and 48 hr. in winter, with, in addition, not more than 12 hr. on week-days and 3 hr. on Sundays in attendance on cattle and horses. The rate for female workers aged 16 years and over is 5d. per hr. Differential overtime rates are in the case of male workers aged 21 years and over 10d. per hr. on week-days and 1s. per hr. on Sundays, and that of female workers aged 16 years and over 7½d. per hr.

North Riding of Yorkshire.—An Order continuing the existing minimum and overtime rates of wages for male and female workers to come into operation on the 2nd Nov. (when the existing rates are due to expire) and to continue in force until further notice. The minimum rate for male workers of 21 years of age and over is 33s. per wk. of 48 hr. in winter and 52½ hr. in summer, the rate payable in respect of employment in excess of those hours in attendance on stock being 4d. per hr. where the worker is boarded and lodged, and 8d. per hr. if he is not so boarded and lodged. The overtime rates are 10d. per hr. on week-days and 1s. per hr. on Sundays. In the case of female workers of 18

years of age and over the minimum rate is 6d. per hr. for a wk. of 44 hr., with overtime at 9d. per hr.

West Riding of Yorkshire.—An Order to operate as from the 24th Nov. continuing the present minimum and overtime rates of wages for male and female workers up to the 23rd Nov., 1926. The rates in the case of male workers living in and hired by the year or half-year are: foremen, £85 16s. 0d. per annum; beastmen and shepherds, £83 4s. 0d. per annum; waggoners, £78 per annum; and lesser sums for lads, the rate in each case to be payable in respect of a wk. of 52½ hr. in summer (first Monday in March to last Saturday in Oct.), and of 48 hr. in winter (the remainder of the year), with, in addition, 12 hr. a wk. on week-days and 3 hr. on Sundays for work in connection with care of and attention to stock.

In the case of horsemen, beastmen and shepherds not living in, the rate for workers aged 21 and over is 42s. per wk. of 52½ hr. in summer and of 48 hr. in winter, and, in addition, 12 hr. per wk. on week-days and 3 hr. on Sundays for work in connection with the care of and attention to stock. In the case of other male workers, the rate for those aged 21 and over is 36s. per wk. of 52½ hr. in summer and of 48 hr. in winter. The rate for female workers aged 14 years and over is 5d. per hr. The differential overtime rates are in the case of male workers aged 18 years and over 11d. per hr. on week-days and 1s. 1d. per hr. on Sundays, and in the case of female workers aged 14 years and over 7½d. per hr. both on week-days and Sundays.

Carmarthenshire.—An Order fixing minimum and overtime rates of wages for male and female workers to come into force on the 15th Nov. (when the existing rates are due to expire) and to continue in force until the 14th Nov., 1926. The minimum rate for male workers of 21 years of age and over is 31s. per wk. of 54 hr., instead of 30s. as at present, overtime being payable at 8½d. per hr. In the case of female workers, the rates remain unchanged, the minimum rate in the case of workers of 18 and over being 5d. per hr., with overtime at 6d. per hr.

Copies of the Orders in full can be obtained on application to the Secretary of the Agricultural Wages Board.

The next meeting of the Board will be held on Tuesday, the 8th December, 1925.

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Foot-and-Mouth Disease.—Disease has unfortunately continued to spread since the November issue of the *Journal*, and new centres have been brought to light in Oxfordshire, Derby, Staffs, Essex, Gloucester, and East Sussex.

The position in the areas under restrictions of the "infected areas" type is shown in the following table, which includes the outbreaks occurring therein up to 22nd November:—

Area	*Number of outbreaks*	*Date of last outbreak*
East Sussex	3	26 Oct.
Cheshire	3	28 ,,
Yorkshire	16	22 Nov.
Lancashire	60	19 ,,
Wilts	42	21 ,,
Berks	1	23 ,,
Warwickshire	9	21 ,,
Northants	7	11 ,,
Rutland	2	9 ,,
Leicester	12	22 ,,
Oxfords	2	16 ,,
Derby	6	22 ,,
Stafford	4	22 ,,
Essex	3	16 ,,
Gloucester	5	21 ,,
Sussex, E. (Battle district)	1	12 ,,

The number of outbreaks from 1st January to 22nd November was 204, of which 179 have been confirmed since 25th September, in seventeen counties

These outbreaks have necessitated the slaughter of 6,481 cattle, 7,276 sheep, 2,567 swine, and 28 goats.

Foot-and-Mouth Disease.—Midlands and South of England (Regulation of Movement of Animals) Order of 1925.—The area covered by this partial Standstill Order, which came into force at midnight on 16th November, embraces the counties (including all county and other boroughs geographically situated therein) of Bedford, Berks, Buckingham, Cambridge, Chester, Derby, Dorset, Essex, Gloucester, Hereford, Hertford, Huntingdon, Isle of Ely, Isle of Wight, Kent, Lancaster (except the county borough of Barrow-in-Furness and the petty sessional divisions of North Lonsdale and Hawkshead), Leicester, Lincoln (Holland and Kesteven divisions), London, Middlesex, Monmouth, Northampton, Nottingham, Oxford, Rutland, Salop, Soke of Peterborough, Somerset, Southampton, Stafford, Sussex East and West, Surrey, Warwick, Wilts, Worcester, the West Riding of Yorkshire (excluding the city of York), and the petty sessional division of Overton in the county of Flint.

Foot-and-Mouth Disease (Packing Materials) Order of 1925.—Under the terms of this Order, which came into force on 19th November, no hay or straw from any source, which has been used for packing purposes, shall be brought into contact with any animal in Great Britain or be removed from any premises, except used as packing, or for the purpose of destruction. Hay or straw which has been used for packing purposes, if not so used again, shall be destroyed. No tree, shrub, plant, bulb or other horticultural product which is packed in hay or straw shall be exposed for sale, or permitted to be stored, on any premises whilst such premises are being used for the purpose of the sale or exposure for sale of animals. Similarly no box, crate, basket or other receptacle which has been used for, or in connection with the carriage of meat, meat products, offals or other parts of a carcass (not being cooked or preserved meats or meat essences) shall be brought into contact with any animal in Great Britain; and the same prohibition extends to any cloths, wrappings, sacking or other material used for wrapping these articles unless and until they have been boiled or otherwise sterilised after being so used. In this Order "animals" means cattle, sheep, goats, other ruminating animals and swine.

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NOTES FOR THE MONTH.

Pigs and Potatoes.

THE outlook for pig-keepers is for the time being decidedly favourable, a result which may be attributed mainly to the drop in the number of pigs at home, and to the falling off of supplies of bacon and ham from the principal exporting countries.

The satisfactory prices now obtainable for pigs coincide with an increased supply of potatoes, the market value of which is considerably lower than that of last year. Farmers, therefore, who are in possession of both pigs and potatoes should be able materially to help out their returns from " ware and seed " by utilising small and waste potatoes for pig-feeding. As compared with other foods available for this purpose, potatoes have a value on the farm of slightly more than £2 per ton.

In former times, before meals and offals were procurable in all their variety and complexity, waste potatoes formed the basis of the diet of many thriving and thrifty pigs. The method of preparing the potatoes, which has since been justified by modern scientific investigation, was to boil the potatoes—often along with swedes or mangolds. After they were boiled long enough the allowance of meal—barley or other cereal—was scattered over the mass and thoroughly stirred into it. The mixture when cool was fed with skim milk or buttermilk when available, and though there appear to be no accurate data as to the actual quantities fed, or rate of progress made, it is safe to assert that the amount of meal used was considerably less than under modern methods, and that the time taken to produce the primest bacon compared not unfavourably with the best achievements of modern science.

Exactitude, however, is the aim of the pig-feeder to-day. Scientists tell him that 4 lb. of potatoes are equivalent to 1 lb. of barley meal, and he may therefore substitute accord-

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ingly. He will not be far out if he substitutes at the rate of 4 lb. of potatoes for 1 lb. of the ordinary mixed meals such as middlings, maize, barley and palm kernel, using up to 8 lb. or so of potatoes according to the age and progress of the pig. On meals alone it is found that pigs require about 1 lb. per day for each month of age. Details of the best proportions of meals to use will be found in Miscellaneous Publications, No. 48.*

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Manuring of Potatoes.

THE potato crop in Great Britain is of such importance that great interest was bound to be taken in the conference which was held at Rothamsted on 20th November last. The country's requirements in potatoes are round about 4,000,000 tons annually, and it is only exceptionally that the home crop is sufficient to meet demands, so that a proportion of the requirements is imported.

The question of manuring is intimately connected with soil, climate and supply of moisture, while the disease factor can scarcely remain unconsidered. The use of farmyard manure is often important, not because of the manurial constituents it contains, but because of its influence in ameliorating the condition of the soil and in conserving moisture. Artificials should probably only rarely be omitted, or a full yield can hardly be expected—but what artificials should be applied is a question again depending on local conditions. Superphosphate is almost always valuable; sulphate of potash is most commonly the best of the potash manures; 1 cwt. of sulphate of ammonia rarely fails to add a ton to the yield, and a further cwt. or so may prove equally valuable; and lime should not be applied for or immediately preceding potatoes.

Special attention is directed to the five articles in this issue which deal with manuring for the potato crop. These articles summarise the papers given at the Rothamsted conference, and may well receive very careful attention at the hands of all farmers who grow potatoes—and those who do not are probably very few.

* Obtainable direct from the Ministry, 10, Whitehall Place, S.W.1., price 1s. net, post free.

Agricultural Education: Arrangements between Ministry and Board of Education.

✓ THE Ministry and the Board of Education have for some time past had under consideration the question of the respective responsibilities, financial and other, of the two Departments in the sphere of agricultural education.

Since 1912, the arrangements between the two Departments have been regulated by a concordat, which resulted in the Board of Education being responsible for aiding expenditure by Local Education Authorities on agricultural education intended for students below the age of sixteen or seventeen, and the Ministry aiding expenditure on the agricultural education of students above that age.

Generally speaking the arrangement has worked smoothly and satisfactorily, and progress has been made in the development of schemes of county agricultural education. There has been, however, one weak point, namely, that the fixing of the age limit above mentioned as the criterion to decide which of the two Departments should aid the local expenditure has tended to confine the provision of agricultural instruction to students above the age of sixteen, and to exclude from its purview those between the school leaving age and sixteen, for whom at present little organised further education is generally available, at least in rural districts. This tendency has been strengthened by the fact that agricultural education and general education are often dealt with by separate Committees of the County Council—a situation arising chiefly from the passing of the Ministry of Agriculture and Fisheries Act, 1919, under Section 7 of which the responsibility for the supervision of agricultural education in many counties has been transferred from the Education Committee to the Agricultural Committee.

It has thus come about that only limited educational facilities are now provided whereby children on leaving school can be interested in the subject of an agricultural career. By the time they have reached the age of 16, when County Council instruction is available, they have often become attracted to other spheres of work, and the opportunity has been missed of securing their sympathy with a rural occupation. On the other hand, the children who on leaving school do go into some agricultural pursuit, are found not infrequently to have lost during the two or three years before they reach the age of sixteen much of the basis of general knowledge which is required in order that they may fully understand and profit by agricultural instruction.

The Ministry and the Board of Education have now agreed that the division of responsibility between the Departments on the basis of student age should be abandoned, and should be replaced by an arrangement under which grants would be paid by one or other Department according to the subject of instruction provided. The Ministry's Regulations have been revised accordingly, and a copy of the new regulation has been sent to all County Agricultural Education Authorities (Circular Letter T.E.3618, dated the 25th November, 1925).

The arrangement of day and evening part-time courses including instruction in both agricultural and general subjects will, as far as possible, be encouraged by the Ministry and by the Board of Education. Where a course of this nature is primarily agricultural it will be aided by the Ministry. Where the elements of general instruction predominate it will be aided by the Board. There may occasionally be a difficulty in determining whether a proposed course should be classified under the head of "agricultural" or "general" education. This question will come before the Local Authority in the first instance: and if the Ministry and the Board are called on to decide which Department should aid a doubtful course, they will ordinarily be guided by the consideration whether the person who has arranged and supervised the course as a whole is a member of the County Agricultural Education Staff or not.

The new regulation comes into force on the 1st January, 1926. County Agricultural Education Authorities have been asked to furnish their views as to (i) the desirability of providing agricultural, or mainly agricultural courses for students between the ages of 14 and 16; and (ii) how far, and by what means, the need for such courses can be met. The Ministry hopes at a later date to be able to formulate suggestions as to part-time courses including instruction in both agricultural and general subjects, but meanwhile it does not desire to delay the operation of the new arrangement, or the consideration by Authorities of any proposals which they may desire to put forward under the revised regulations. In counties where matters relating to agricultural education stand referred to the Agricultural Committee, that Committee will doubtless consult with the Education Committee on the whole subject of part-time courses for students under 16.

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Egg Marketing in England and Wales.

THE meeting convened jointly by the National Farmers' Union and the National Poultry Council to discuss marketing problems will take place on 27th January. There are few readers of this *Journal* who will not be directly or indirectly affected by this conference, and the majority will follow the results with anxious interest. It is, therefore, at an apposite moment that the Ministry is publishing the 10th number of its Economic Series, entitled "Egg Marketing in England and Wales." This volume, which will be on sale at H.M. Stationery Office on or about 15th January, presents a clear description of the working of the marketing system. Everyone in the egg trade, whether producer, higgler, dealer, wholesaler or retailer, or whatever he may be, knows his own side of the business, but few know every side of it, and the holding of this conference makes all the more imperative a mutual understanding based on a real knowledge of the difficulties which beset each and all. The Report, however, goes farther than this in that it is a serious attempt to convince that part of the industry which still requires conviction, that the English egg trade is confronted with a somewhat menacing situation arising from recent legislative developments in importing countries. With a view to assisting producers and distributors, and more particularly their representative associations, to decide on the nature and extent of the action desirable to meet these new conditions, numerous constructive proposals are developed in the Report in some detail. A careful study of this Report cannot fail to be of considerable help to all who feel the need for a national effort, expressed through better marketing, to give the home-produced egg an unassailable position in the home markets.

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A Solution of the Whey Problem.

IN the February, 1925, issue of this *Journal*, an article was published dealing with the experiments in the manufacture of milk sugar from whey, which were carried out at the Ministry's Lactose Factory at Haslington and outlined the process which, at that time, had been evolved as a result of the investigation. Since July, 1924, when the factory was placed under the control of University College, Reading, certain changes have been introduced and the investigation has followed more on the lines of a practical commercial test. The results obtained under this modified process have produced satisfactory

evidence that the extraction of the first crop of lactose crystals, combined with the manufacture of the molasses into animal foods, constitute a profitable solution of the whey problem.

A report giving a full technical account of the processes and their results has recently been issued by the Ministry under the title "Research Monograph No. 5."*

* * * * * *

Coloured Wall Diagrams of Plant Pests and Diseases.

A REDUCED monotone reproduction of the third of the Series of Coloured Wall Diagrams is given in this issue. The subject is Apple and Pear Scab. and the attacks of the Scab fungus upon the leafy shoots of the tree, upon the fruits and upon twigs in winter time are shown in technically correct delineations finely printed by the four-colour process. This series of wall diagrams has been prepared by the Ministry to illustrate pests and diseases which attack agricultural and horticultural crops and should prove of great service to agricultural, horticultural and allotment societies; to local education authorities for use in rural schools; to museums, colleges and public schools; to farmers, fruit growers and private individuals. The price of each diagram, 30 in. by 20 in., unmounted, is 3s., or mounted and on rollers, 5s. (post free), a free descriptive leaflet being included. Four diagrams are now ready, the other three illustrating (1) the Apple Blossom Weevil, (2) Winter Moth and (4) Silver Leaf.

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Agricultural Education among Small Holders: Demonstration Small Holding in Dorset.

AN interesting and encouraging instance of the value of educational work among small holders is provided by the results which are being obtained in an experiment in Dorset on one of the County Council's small holdings. The occupier works under the immediate direction of the Agricultural Organiser, the arrangement being that the county pays for those requisites, up to a limit of £50, that the small holder would not purchase in the ordinary course of his business. The tenant on his part puts into practice the advice of the Organiser. This arrangement has now been in force for about ten months, and appears to be working out most satisfactorily.

* Obtainable from the Ministry's Offices, 10, Whitehall Place, S.W.1. price 2s. 6d., post free.

Fig. 1.—Reduced reproduction in black and white of coloured Wall Diagram No. 3.

The crops of winter and spring oats and mangolds obtained by the tenant have been extremely good, and the results of putting into operation the Organiser's advice on the rationing of live stock have been that the milk yields are well in advance of those for the previous year. The pastures have also been improved. In addition, careful accounts and costings are being kept, and these so far show that the holding is likely to prove most successful financially. It is particularly significant that whereas the other small holders in the district were at first inclined to doubt the value of the experiment, they have now completely changed their attitude and are watching the results of scientific management with the greatest interest. Work more or less on similar lines is being carried out in a number of other places throughout the country, and it is hoped that in time this method of practical instruction will prove of considerable value to small holders.

* * * * * *

A Successful Co-operative Effort on a Farm Settlement.

The advantages of co-operative effort are illustrated in connection with the sale of milk, produced by most of the tenants on the Ministry's Small Holdings Settlement at Heath Hill, Salop.

For several years the bulk of the milk produced on the settlement has been sold at prices generally regarded as unsatisfactory. Shortly before the termination of the contracts for 1924-25, a meeting was held under the auspices of the Shifnal Branch of the National Farmers' Union, of which most of the tenants are members, with the result that a Committee was appointed to explore the possibilities of the collective sale of milk. The Committee succeeded in arranging a contract for the year October, 1925, to September, 1926, with the Midland Counties Dairy, Ltd., at prices averaging over 2d. per gallon more than those obtained during the year 1924-25.

Most of the tenants on the settlement are supplying milk under the co-operative scheme, and the remainder have also benefited by obtaining higher prices elsewhere.

* * * * * *

Enforcement of Minimum Rates of Wages.

DURING the month [illegible] oceedings were instituted against eight employers for failure to pay the minimum and overtime rates of wages fixed by the Orders of the Agricultural Wages Board for workers employed in agriculture.

The particulars of the cases are as follows:—

County.	*Court.*	*Fines.* £ s. d.	*Costs.* £ s. d.	*Arrears of wages ordered to be paid.* £ s. d.
Lancs.	Lytham	—	—	9 13 3
Wilts.	Warminster	—	—	7 13 2
"	"	3 0 0	—	5 2 0
Hereford	Abbeydore	—	—	4 18 0
"	"	1 0 0	—	10 3 6
Radnor	Clyro	—	5 1 0	11 4 0
Derby	Derby	0 10 0	—	5 1 3
Lincs.	Grantham	1 10 0	5 5 0	21 12 6

Proceedings were also instituted against an employer at Spilsby under Section 9 (3A) (hindering an Officer in the exercise of his duties) and Section 9 (3B) (refusal to give information) of the Agricultural Wages (Regulation) Act. The defendant was fined £15, including costs.

* * * * * *

The Agricultural Index Number.

THE general level of the prices of agricultural produce during November was the same as in October, being 53 per cent. above the corresponding month of 1911-13. In November, 1924, the index number was 64 per cent. above pre-war. The reduction as compared with a year ago was due to the lower prices ruling for grain, milk and potatoes.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.	1925
January ...	200	183	75	68	61	70
February ...	195	167	79	63	61	67
March ...	189	150	77	59	57	65
April ...	202	149	70	54	53	58
May ...	180	119	71	54	56	57
June ...	175	112	68	51	58	55
July ...	186	112	72	53	52	51
August ...	193	131	67	54	59	56
September	202	116	57	56	60	57
October ...	194	86	59	51	63	53
November	193	79	62	53	64	53
December	184	76	59	56	63	—

Wheat prices were appreciably higher during November than in the previous month, the average of 11s. 2d. per cwt. being

9d. per cwt. above the Oc[illegible]. Barley, however, averaged 9d. per cwt. less at 11s. 6d. per cwt., while oats declined by 1d. per cwt. to 9s. 1d. per cwt. Wheat was relatively the dearest of any of the grain crops at 49 per cent. above pre-war, barley being 35 per cent. and oats 30 per cent. above 1911-13. As compared with November, 1924, all grain was much cheaper, particularly barley, but the level of prices in 1925 was appreciably above 1923.

Prices of fat cattle experienced little change during November, and the index number was again 48 per cent. above 1911-13. The rise of ½d. per lb. in the prices of fat sheep was practically proportionate to the increase between October and November in the basic years and the index number showed a rise of only one point to 63 per cent. above pre-war. Fat pigs continued to become dearer and baconers were 79 per cent. and porkers 75 per cent. above 1911-13, showing increases of 9 points and 4 points respectively as compared with October. As compared with November, 1924 or 1923, there was practically no difference in the price of fat cattle, but sheep were much cheaper than a year ago and rather cheaper than two years ago, while pigs were appreciably dearer than in either of the previous two Novembers.

Many markets have been closed for store stock as a result of the restrictions on movement of stock owing to outbreaks of Foot-and-Mouth Disease, and the index numbers are consequently based on fewer returns than usual. Prices of store cattle and sheep were fairly similar to those of the previous month but store pigs became rather dearer, whereas usually prices decline in November.

Milk prices were unchanged on the month at 74 per cent. above pre-war. The rise in butter prices was exactly proportionate to that shown in the basic years, and the index number was again 71 per cent. above 1911-13. Cheese was slightly dearer on the month but the increase was relatively small for November, and the index number declined by 2 points. The index figures for all classes of dairy produce are now very close together, all lying between 71 and 75 per cent. above pre-war. Eggs rose by 5½d. per dozen as compared with October, but this rise was relatively not so sharp as before the war and the index number fell by 10 points to 80 per cent. above 1911-13.

There was an increase of 3s. 6d. per ton in the average price of potatoes, bringing the index number to 60 per cent. above 1911-13, and appreciably above the average of all agricultural commodities. November prices were, however, much lower than

the exceptional prices of last autumn. Hay prices were slightly easier in November.

Apples averaged 35 per cent. above pre-war, being rather dearer on the month. The index number for vegetables advanced 5 points to 53 per cent. above 1911-13. Brussels sprouts were relatively very cheap at 12 per cent. above pre-war, cabbage were 45 per cent., cauliflowers 59 per cent., onions 39 per cent., celery 73 per cent. and carrots 92 per cent. above 1911-13.

Index numbers of different commodities during recent months and in November, 1923 and 1924, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	1923.	1924.	1925.			
Commodity.	Nov.	Nov.	Aug.	Sept.	Oct.	Nov.
Wheat ...	22	68	47	53	40	49
Barley ...	25	89	62	69	44	35
Oats	24	45	43	43	33	30
Fat cattle ...	47	47	54	53	48	48
Fat sheep ...	77	90	76	69	62	63
Bacon pigs ...	40	46	52	66	70	79
Pork pigs ...	52	46	56	65	71	75
Dairy cows ...	57	60	50	46	48	42
Store cattle ...	25	36	39	37	32	32
Store sheep ...	88	94	91	90	69	68
Store pigs ...	75	33	57	75	88	97
Eggs... ...	92	84	67	75	90	80
Poultry ...	58	62	58	58	48	49
Milk	75	82	62	63	74	74
Butter ...	64	74	73	70	71	71
Cheese ...	73	38	78	77	77	75
Potatoes ...	80	168	67	53	53	60
Hay	—1*	1	3	4	1	—1*

* Decrease.

* * * * * *

MANURIAL REQUIREMENTS OF THE POTATO CROP.

SIR JOHN RUSSELL, D.Sc., F.R.S.,
Director, Rothamsted Experimental Station, Harpenden.

The following four articles, by Sir John Russell and Messrs. T. Eden, J. C. Wallace and R. W. Wheldon, are summaries of papers with which a conference on the Manuring of Potatoes was opened at Rothamsted on 20th November last. A fifth article, by Mr. F. C. Heigham, summarises the various points brought out in the papers and in the discussion which followed.

THE purpose of these conferences is to bring together those engaged in the development of agricultural science and those whose daily task is the working of agricultural practice. Thanks to the fostering care of the Ministry of Agriculture, agricultural science is now highly developed in this country, but if it is to prove effective there must be direct discussion and co-operation between the scientific worker and those engaged in the industry. On our side, therefore, we are anxious to take such steps as we can to ensure this co-operation.

No apology is needed for devoting an entire conference to the manuring of potatoes. This crop is one of the most interesting and important in Great Britain, and it shows what the British farmer can do when economic conditions allow. The decline in arable farming is one of the most disquieting features in the countryside to-day. But the potato is a brilliant exception to the general rule; for while the area under this crop in England and Wales had been 355,000 acres only in 1866, it rose to more than 507,000 acres in the period 1913-1922. The total output was not officially estimated until 1884; for the five years 1885-1889 it was 2.4 million tons for England and Wales; for the years 1920-1924 it was 3.1 million tons, and for 1922—a rather fruitful year—it was 4 million tons. The increase has been specially marked in those regions well suited to the crop. The area under potatoes in Lincolnshire in 1866 was only 35,500 acres, round which it stayed for many years; by 1922 it had risen to 108,250 acres.

It is not suggested, [illegible] r should indefinitely increase the acreage of potatoes, but the deduction seems justifiable that the farmer should discover what crops are best suited to his land and then grow them well.

In any discussion of the manurial requirements of the potato crop three considerations have always to be borne in mind.

(1) **Manuring Subordinate to Soil and Climate.**—The first is that manuring, while more necessary for potatoes than for any other crop, is subordinate in importance to the soil and climatic conditions: if these are unfavourable no skill in manuring will avail to ensure a profitable yield. The potato particularly needs a liberal supply of air to the roots and underground stems in order that tubers may easily form; it also needs a proper temperature and a sufficient supply of moisture to allow of adequate leaf activity. These three features, air, water, and temperature, all essential to a good yield, are determined mainly by the soil conditions and the climate, and only to a small extent by the manures.

(2) **The Disease Factor is very Important.**—The second consideration is that disease is a more important factor for the potato crop than for any other grown on the farm, and two of the commonest diseases are affected by manuring, viz., ordinary scab and blight.

Growers have long recognised that alkaline manures tend to favour scab, and for this reason they do not as a rule apply lime or basic slag to the soil for this crop. Occasionally one meets an exception, but in general the lime is supplied to the seeds ley or some other crop not immediately preceding the potatoes, so that it has time to become well distributed in the soil.

A great amount of work on the relation of manuring to potato blight, done some 40 years ago before spraying became common, showed that nitrogenous manures increased the liability to blight, while potash manures tended to keep it off. There has been little recent work with modern varieties and conditions of growth, and the question needs further study, but it is widely recognised that healthy growth, not only of potatoes but of other crops, requires a proper relation between the nitrogen and the potash.*

* See Dr. Bewley's interesting reports on tomato diseases in the Reports of the Experimental and Research Station, Cheshunt.

(3) **There are Yield Limitations for all Crops.**—The third consideration is that no crop can grow beyond a certain size, however good the manurial scheme may be. A limit is set by the soil, the climate, and finally by the variety itself; if higher yields are wanted a new variety must be sought, but even then growth cannot exceed a certain amount; giants are as rare among plants as among animals.

The result of these limitations of manurial action is that fertilisers may take the crop up to a certain size but will not take it beyond. At Rothamsted the limit is usually about 11 tons per acre; the soil is too heavy and too sticky in wet weather to allow of the free access of air to the tubers that would be necessary for larger crops. A manurial scheme that will give 11 tons per acre may be cheapened, but for our farm it cannot be improved in the direction of bigger crop production since the crop is already as large as its nature and the soil allow.

The dominating effect of soil type in determining the vitally important soil moisture and air conditions explains why potatoes are commonly restricted in this country to the fens and the light loams such as the silts of Lincolnshire. On all these soils the crop finds sufficient moisture and abundant air for its roots, while the farmer has the great advantage that the labour of setting and lifting is reduced to a minimum.

Soil moisture and air supply are unaffected by artificial manures, but they are improved by farmyard manure and lime. It is unfortunate that lime is not usually suitable for the potato crop, for it would make easier the cultivation of potatoes on heavy soils; it can nevertheless be applied earlier in the rotation. Farmyard manure is safer and also more effective. As the only manure that both feeds the plant and also helps to ensure the necessary air and water to the roots, farmyard manure should always form the basis for the manuring of the potato crop. This double action of farmyard manure affects the time when it should be applied. If wanted chiefly for its plant food it can be given quite well in the spring, the losses by drainage being thus minimised. If, however, it is wanted to improve the soil conditions, particularly the water supply on a light soil, it is best ploughed in during the autumn or early winter, because it exerts its physical effect best when it has become decomposed and mingled with the soil. So far as any general rule can be made, winter application is probably

best in districts having a rainfall below 30 inches, and spring application where the rainfall exceeds 30 inches.

Artificial Manures.—No other crop receives so much artificial fertiliser or responds so well to it as the potato, whether one thinks in terms of money or of weight of crop per acre. Of all the crops grown in this country the potato is the most efficient converter of artificial fertilisers into human food. It is among farm crops what the pig is among farm animals, the pig, as is well known, being the most efficient transformer of animal food into human food.

All three groups of artificial fertilisers are used for potatoes, incomplete mixtures being given only in special cases.

Nitrogen.—Of the nitrogenous manures the commonest is sulphate of ammonia; neither nitrate of soda nor nitrate of lime is much used, nor has either been made the subject of many experiments. It has been repeatedly shown that sulphate of ammonia can profitably be applied to potatoes even when farmyard manure has already been given, and frequently an additional 20 cwt. of potatoes per acre is obtained by the addition of 1 cwt. sulphate of ammonia. Nitrogenous manures are the most certain of all to give crop increases—so much so that it is possible to draw up a table showing the amount of increase that may reasonably be expected from them.

Season of course comes into the matter, but to nothing like the extent that it does for phosphates or potash. The increased potato crop for 1 cwt. sulphate of ammonia per acre has been :—

	Pre-War Experiments: *Average.*	*Rothamsted.* 1922	1923	1924	1925
Cwt. per acre ...	20	25	22-25	20	22

The figures are remarkably uniform considering the marked differences in season.

Additions of sulphate of ammonia do not continue indefinitely to give increased potato yields. Mr. Eden will show that profitable returns are obtained on our farm with 3 cwt. per acre but not beyond; the crop is then up to its limit of 11 tons per acre. This accords with the well-known Law of Diminishing Returns; for every farm there is a stage beyond which additional expenditure on fertilisers or other means of increasing the crop ceases to be profitable. On soils better suited to potatoes and therefore easily capable of exceeding the

Rothamsted limit of 11 tons per acre, higher quantities of sulphate of ammonia than 3 cwt. per acre might be profitable.

Phosphates.—The phosphatic manuring of potatoes is at present in an interesting position. A few years ago it was universally accepted that potatoes should be generously manured with superphosphate. There is direct experimental evidence of the advantage of superphosphate on the black fen soil on which quantities of potatoes are grown; a considerable body of farming experience shows its value on many of the glacial soils, such as the Norfolk loams. All this accords with the well known effect of superphosphate in encouraging the development of roots.

Then came Mr. Wallace's experiments, in which he showed that while superphosphate is necessary for the potato crop, it cannot at Kirton advantageously be given at a greater rate than 2 cwt. per acre. Larger quantities not only did no good, they were actually harmful. The results were unexpected, but they are quite intelligible. They agree with another property of superphosphate: its power of hastening ripening. *i.e.*, seed production, and therefore curtailing the period of vegetative growth. A parallel case is afforded by the Rothamsted experiments with barley, on which it has happened on a light dry soil that superphosphate reduced the yield. This barley result is unusual, and it may happen that Mr. Wallace's results are unusual also. The Kirton soil is a silt recently deposited by the sea, and it may more readily supply the potato with the requisite amount of phosphates than would the glacial soils on which many potatoes are grown. There will certainly be repetitions of Mr. Wallace's experiments in other counties.

Potash.—The importance of potassic manuring for potatoes is well recognised. Where farmyard manure is liberally applied it may not always happen that potassic fertilisers produce any great effect. Farmyard manure contains a considerable quantity of potash, and in a 15-ton dressing there is as much as is present in 4 cwt. of sulphate of potash, though in a less available form. This quantity may suffice for the needs of the crop, but it would be unwise to run risks—the value of the crop, the uncertainty of the seasons, and the benefit of the potash when it is needed all being too great to justify the omission of potassic fertilisers. Moreover, there is no evidence that farmyard manure improves the quality of the crop. When the dressings of farmyard manure are not large, or where no farmyard manure is being given, the effects of potassic fertilisers are often striking.

The sulphate and the muriate usually give similar increases in yield, but there are instances where sometimes the sulphate and sometimes the chloride have given the larger crop. The grower who sells the crop straight off the field to a customer not particularly interested in quality can generally use the chloride instead of the sulphate if he wishes. The lower grade potash fertilisers are as a rule less effective than the muriate or the sulphate and are not recommended for potatoes. Kainit has sometimes given good results, *e.g.*, on the dry soils of the Lincoln cliff, but in our experience this is exceptional. Possibly 30 per cent. potash salts may be good enough, but with so valuable a crop it is unwise to take risks.

Where quality is important it is safer to use the sulphate. Quality is notoriously difficult to define or to characterise, but in cooking tests potatoes manured with the sulphate usually come out better than those manured with the chloride. Chemical analysis gives definite figures, and Mr. Eden has shown that potatoes manured with the sulphate contain more dry matter per ton and more starch in the dry matter than potatoes grown with the chloride. The sulphate therefore yields more food per acre than the chloride even when it gives no larger crops.

Potassic manures and nitrogenous manures both increase the crop, but in different ways. The tubers contain two distinct parts: cells which may be likened to little boxes. and cell contents which include the starch and the proteins, two of the valuable food constituents of the potato, and also a good deal of water. Nitrogenous manures lead to the formation of more boxes, but potassic manures, and especially potassium sulphate, cause the boxes to become better packed with human food.

These quality problems become obscured when farmyard manure is used. It then becomes difficult to say with certainty whether potassic fertilisers improve the quality, though it seems evident that the harmful effect of the low grade salts is mitigated.

A further effect of potassic fertilisers is to increase the health and vigour of the plants: usually it is necessary to preserve a balance between the nitrogen and the potash.

Magnesia.—Some potato growers use magnesia (MgO) as a fertiliser, but there is no evidence that it is effective. Magnesium sulphate acted well at two northern centres, but the necessary conditions are not known, and we do not at present recommend it. Further experiment is, however, necessary, especially in view of the German conclusion that magnesium sulphate is beneficial in the presence of farmyard manure.

THE MANURING OF POTATOES: THE ROTHAMSTED EXPERIMENTS.

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SINCE 1921 manurial experiments on potatoes at Rothamsted have aimed at evaluating the increase in yield due to (1) nitrogenous manure in the form of sulphate of ammonia and (2) various forms of potash salts. The trials in all cases have been concerned only with one variable factor; all the other conditions, whether manurial or cultural, have been kept as constant as field conditions allow. The plots were in all cases one-fiftieth of an acre. This area allows of some 250-300 sets per plot, and on triplicate plots a good average is obtainable. In 1924, on the potash series, quadruplicate plots were employed. With the exception of the nitrogenous experiments of 1921, which were planted with Arran Chief, the variety has been Kerr's Pink throughout. In 1922 " once grown " seed was used, but on all other occasions seed fresh from Scotland has been obtained.

Nitrogenous Manures.—In the case of plots receiving dung the basal dressing has been 4 cwt. superphosphate and 1½ cwt. sulphate of potash. In the absence of dung the larger quantities, 6 cwt. superphosphate and 2 cwt. sulphate of potash were used. The following averages are from undunged plots and relate to the three years 1922-1924.

YIELD OF POTATOES IN TONS PER ACRE.

Treatment.	*With seed.*	*1½ cwt. sulph. amm. top dressed in addition.*
Basal	8.52	—
„ + 1½ cwt. sulph. amm.	10.19	10.78
„ + 3 „ „ „	11.17	11.24

From these figures, three facts of interest emerge. In the first place, the increase in yield due to 1 cwt. of sulphate of ammonia is considerable, averaging 1.1 tons per acre. Over a considerable number of years, with varying seasonal conditions, this return of one ton for each hundredweight of sulphate of ammonia used has recurred, and this stable increase must be counted as one of the features of nitrogenous manuring of potatoes. With large quantities the return is of course diminished.

Secondly, 11 tons per acre represents the maximum average yield obtainable on a Rothamsted soil with the basal manuring previously mentioned, a yield corresponding to an outlay of

3 cwt. of sulphate of ammonia per acre. The Rothamsted soil is admittedly not a potato soil.

Finally, on the basis of these results, the practice of top dressing cannot be recommended. Although the potato goes on producing and storing foodstuffs almost to the end of its life, the final yield cannot be enhanced by delaying the application of a part of the nitrogen supply as is so profitably done with cereals. Top dressing with ½ cwt. sulphate of ammonia increased the yield by 0.68 tons, whilst an equivalent amount applied with the seed gave an increase just short of a ton.

Potash Manures.—Over the period 1921-1924 three kinds of potash manure have been used—sulphate of potash, muriate of potash, and low grade salts giving an analysis of about 20 per cent. of potash (K_2O). Parallel series, dunged and undunged, have been carried on with the following manurial dressings:—With 15 tons per acre of dung, 4 cwt. superphosphate, and 1½ cwt. sulphate of ammonia; without dung, 6 cwt. superphosphate and 2 cwt. sulphate of ammonia. The potash dressings have been equivalent to 1½ and 2 cwt. of sulphate of potash respectively in whatever form they have been applied.

In marked contrast to the effects of nitrogenous manuring of potatoes, potash manuring gives no stable increase. The seasonal effect is so marked that whilst, in a dry year like 1921, or a year with a severe spring drought such as 1922, the crop responds well to potash, in wet years the gain is much diminished. The following summaries give the actual yields and averages.

WITH DUNG.

	Yield in tons per acre.				
	1921.	1922.	1923.	1924.	Average.
Basal only	3.48	8.03	11.66	9.18	8.09
„ + sulphate of potash...	3.94	9.55	12.45	8.82	8.69
„ + muriate of potash ...	3.51	9.21	13.28	8.70	8.68
„ + low grade salts ...	3.48	9.49	10.48	9.25	8.18
Seasonal average ...	3.60	9.07	11.97	8.99	8.41

WITHOUT DUNG.

	Yield in tons per acre.				
	1921.	1922.	1923.	1924.	Average.
Basal only	1.35	2.47	9.72	6.20	4.94
„ + sulphate of potash...	3.76	8.30	12.25	7.28	7.90
„ + muriate of potash ...	4.12	8.32	12.96	7.15	8.14
„ + low grade salts ...	3.55	8.06	10.61	7.88	7.53
Seasonal average ...	3.20	6.79	11.39	7.13	7.12

From these figures it is evident that, even after allowing extra artificials for the undunged plots, these fall behind the dunged series in yield by 1.29 tons per acre. A second noticeable feature of the dunged series is that the additional applica-

tion of potash has no effect on the average. The difference between the "no-potash" and sulphate of potash plots in this short term experiment is not significantly greater than the error of the experiment computed statistically. On the Rothamsted soil, the 150 lb. of potash available from the dung is sufficient to meet the demands of the average crop expected. Without dung, however, the benefit due to potash manuring is most noticeable, especially on so heavy a soil.

At this stage, it is not clear how important on the whole is the difference between the types of potash manure, but in individual years the inferiority of low grade salts has shown itself. The effect of such manures has been seen at an early stage in the growth characters of the crop. Instead of well-formed thick haulms, spreading foliage, and smooth leaves, the plots receiving low grade salts have been comparable at first with those receiving no potash at all. Some sets have failed to sprout, most have been late in so doing, and a stunted haulm and crinkled leaf has resulted. Nevertheless after a period of heavy rain these plots have shown remarkable powers of recuperation so far as haulm is concerned and have sometimes overtopped the rest, but with a weak and spindley habit. The foliage of "no-potash" plots has turned a characteristic coppery colour and the haulms have died back early.

The Interaction of Factors.—The experiments described above have taken into account the variation of one nutrient substance only. Experiments with two variable factors form the next link in the chain of evidence as to the rôle played by manures in the growth and yield of potatoes. Such an experiment with 0, 2 and 4 cwt. of sulphate of ammonia and sulphate of potash, combined in numerous ways, took place in 1925, and, from the results over a similar period of years, information régarding the behaviour of manures will be available. The importance of this is strikingly exemplified in such a year as 1921 when the "no-manure" plots gave a consistently better yield than those deficient in potash but receiving superphosphate and sulphate of ammonia. More refined methods of plot arrangement, and Mr. Fisher's improved method for estimating the error of such an experiment, will enable the results to be put forward with a confidence hitherto unattainable in field experiments.

Quality.—The field experiments of potash manures have been supplemented by a laboratory investigation into their chemical composition in relation to quality. The ultimate criterion of

quality is the cooking test. Reports from a leading firm of London caterers, and also "home" cooking tests have favoured high grade salts. Low grade salts and absence of potash both tend to give a sodden ill-coloured potato. Analyses have brought out the fact that a relatively watery tuber is not necessarily the worst cooker. It has sometimes happened that the dark-coloured "no-potash" tubers have excelled in dry matter content; such potatoes have, however, been low in starch content.

In the results of the three seasons' produce upon which work has so far been carried out, the seasonal effect on both dry matter and starch content is clearly evident; and, as with yield, in some seasons the fall in the starch content of the potato, due to the use of low grade salts, is well outside the range of experimental error. Dung has twice decreased the starch content and once increased it. Curiously enough any difference it has made was reflected most on the high-grade and least on the low-grade potash plots. No superiority of dunged over undunged plots has been noticeable, except in the case of tubers lacking potash or having low grade salts supplied. Whilst at this stage significant average differences in starch for the various manurial treatments cannot be claimed, the quantity of starch per acre produced not only shows an enhanced value in tubers supplied with potash but definitely gives high grade salts without dung preference over low grade products.

STARCH PER ACRE IN TONS.

	Average of 3 years 1922-24.
Basal manures	0.838
" " + Sulphate of potash ...	1.324
" " + Muriate of potash ..	1.218
" " + Low grade salts ...	0.964

Conclusion.—The experiments described have opened up a large field of inquiry, and so far give consistently the following results:—

(1) Dung is beneficial to yield but not to quality if all necessary artificials are supplied.

(2) Nitrogen shows very uniform returns and can be relied upon to give an increase on Rothamsted soil.

(3) Potash is much more variable in behaviour according to the type of season encountered. In years where the increments are marked, high grade salts give the best returns with a corresponding effect on cooking quality.

(4) The balancing of manurial rations on similar lines to foodstuff rations must be the basis of future investigation.

LINCOLNSHIRE EXPERIMENTS ON THE MANURING OF POTATOES.

J. C. WALLACE.

Soils and Cultivation.—Lincolnshire is perhaps the most important potato-growing district in this country, if not in the world. Contrary to general belief, the district does not consist of black fen soil, but of a sandy alluvial loam, locally known as "silt." Only a very small acreage of black fen soil is found in Lincolnshire. The soil is not high in organic matter, is generally low in potash, rather high in phosphates, contains a great deal of sand, and is easily worked.

Practically one-third of the total area of the Lincolnshire potato-growing district is under potatoes each year. On the average, fields are cropped once in three years with potatoes, but in the early districts, such as those around Boston, Kirton and Freiston, land newly broken up from grass may be cropped continuously for 8 to 12 or more years with potatoes. In these very early districts, lifting usually commences in the second week in June, and very frequently early and second early crops are followed in the same year by a crop of cabbage, cauliflower, etc. In the southern part of the Holland Division, second early and maincrops only are grown.

Farmyard manure is a scarce commodity, and advantage is taken of ploughing in green crops to keep up the fertility of the soil. Cultivation is thorough, deep ploughing being practised, 10 to 14 inches being the common depth. Very frequently the land is sub-soiled in addition, a total depth of 20 to 22 inches of soil being moved. Prepared compound potato manures are generally purchased, and applied at rates varying from 7½ cwt. to 20 cwt. per acre, 10 to 12 cwt. per acre probably being the average. Merchants generally stock two or three standard mixtures. A typical analysis of such a compound would be (for maincrop): 5 per cent. ammonia, 20 per cent. soluble phosphate, 3 per cent. insoluble phosphate, 3 to 4 per cent. potash.

Applied at 10 cwt. per acre, this is equal to a dressing of approximately 2 cwt. sulphate of ammonia, 6¾ cwt. superphosphate, and ⅔ cwt. muriate or sulphate of potash. The chief features of these compound manures are the low percentages of potash and the high percentages of phosphate.

Manuring of Early Potatoes.—The general belief in the district is that early potatoes require a manure containing more ammonia and less potash than is required for maincrops. Early potato manures generally contain 6 or 7 per cent. of ammonia, 20 per cent. of phosphate, and 1 to 2 per cent. of potash. 12½ cwt. compound manure per acre is the average quantity applied, equal to a dressing of approximately 3½ cwt. sulphate of ammonia, 8½ cwt. superphosphate, and ½ cwt. muriate of potash.

Experiments have been carried out for the past three years to ascertain the correct quantity of sulphate of ammonia, superphosphate, and muriate of potash required for the early potato crop. The plots in each case were in duplicate and in some cases in triplicate, and were one-eighth of an acre in size. The basal dressings were at the rate of 4 cwt. superphosphate, 1½ cwt. muriate of potash, and 2½ cwt. sulphate of ammonia per acre. The ingredients under test varied in each case, in the quantity applied, the other two manures remaining standard.

Effect of Sulphate of Ammonia.—In these experiments plots received dressings varying from 1 cwt. to 3½ cwt. per acre. In 1923 and 1924, the plots receiving 2½ cwt. sulphate of ammonia gave the highest yield. In 1925 the plots which received 2 cwt. came out on top. In 1925 the crop was lifted at a very much earlier date than in previous years. On the average of three years' results, the 2½ cwt. plots show the highest yield.

Effect of Potash.—Averages for three years are available. Muriate of potash was used in preference to the sulphate, because on the average, it is likely to yield about the same as the sulphate, and is somewhat cheaper. Quality is not of supreme importance in the case of earlies.

In 1923 a definite increase was obtained with applications up to 2 cwt. per acre. In 1924 and 1925 the 1½ cwt. plots came out top. The average yields work out at 6 tons 16 cwt. in the case of the No Potash plots, 7 tons 17 cwt. on the 1½ cwt. plots, and 7 tons 19 cwt. on the 2 cwt. plots. 1½ cwt. per acre would therefore appear to be a safe and economical dressing.

Effect of Phosphates.—So far only 2 years' results are available in the case of early varieties. In 1924 the outstanding feature was the very small increase due to the superphosphate: 2 cwt. per acre only gave an increase of 4 cwt. of tubers; 4 cwt. an increase of 5½ cwt. over No Phosphate. In 1925, 2 cwt. gave an increase of 17 cwt. over No Phosphate. Plots receiving

4 cwt. and 6 cwt. superphosphate showed no increase over the 2 cwt. plots. The average figures are as follows:—

No phosphate...	...	...	6 tons 17 cwt.
2 cwt. superphosphate ...		...	7 „ 15 „
4 cwt. „	...	...	7 „ 15 „
6 cwt. „	...	...	7 „ 19 „

Compared with the customary dressings of 6 and 8 cwt. of superphosphate per acre applied in compound manures, these figures are particularly remarkable. It may be stated that even more striking results have been obtained on maincrop.

Recommendations on the Manuring of Early Potatoes.—The foregoing experiments show that the following mixture is likely to give satisfactory results:—2½ cwt. sulphate of ammonia, 2 cwt. superphosphate, and 1½ cwt. muriate of potash.

The reduction of the quantity of superphosphate, however, is so far removed from practice that it may be safer to recommend 4 cwt. instead of 2 cwt. in the mixture. It may be remarked that very much heavier dressings may be applied to the potato crop, and probably half as much again of the mixture could be used. It is probably very much a question of getting a correct balance in the mixture. Experiments on maincrop potatoes have shown that in a properly balanced mixture very large quantities may be applied with safety.

Manuring of Maincrop Potatoes.—*The Effect of Ammonia.*—It is customary in Lincolnshire to apply a manure containing approximately 5 per cent. of ammonia to maincrop potatoes. A dressing of 12½ cwt. of compound manure per acre would commonly mean an application of 2½ cwt. sulphate of ammonia per acre.

In these experiments, plots were dressed with varying quantities of sulphate of ammonia up to 3 cwt. in 1923, and 4 cwt. in 1924. Heavier dressings were applied in 1925, but the results are not yet available. In 1923, the 3 cwt. plots gave an increased yield of 4 tons per acre over the yield obtained from the No Ammonia plots. In 1924 increases were obtained up to and including the 4 cwt. plots, the figures being:—

No ammonia	...	...	6 tons 15 cwt.
2 cwt. ammonia	...	...	8 „ 6 „
3 cwt. „	...	...	9 „ 19 „
4 cwt. „	...	...	11 „ 1 „

Any tendency to produce an excessive quantity of foliage by the application of such heavy dressings of sulphate of ammonia was probably counteracted by the percentage (10 per cent.) of potash in the mixture.

Potash on Maincrop Potatoes.—Experiments were first started in 1922 to compare the effect of various sources of potash on the potato crop. Three years' averages give the following figures :—

No potash	8 tons 15 cwt.
2 cwt. sulphate of potash ...	10 „ 17 „
Muriate of potash equal to 2 cwt. sulphate of potash... ...	10 „ 10 „
Kainit equal to 2 cwt. sulphate of potash	9 „ 6 „

On the average the yields obtained from the sulphate and muriate of potash are approximately the same, but the results have not been consistent each year. In 1923 the sulphate gave the heaviest yield, and in 1924 the muriate. It would appear, therefore, that on the average sulphate and muriate will give equal returns. The use of sulphate or muriate is governed entirely by the question of quality, sulphate invariably producing a dry, mealy tuber, compared with a somewhat waxy tuber produced by the muriate. The muriate is slightly cheaper than the sulphate, and the farmer must be guided by the market to which he sends his produce.

With regard to the quantities of potash per acre, it will be seen from the results above that a dressing equivalent to 2 cwt. sulphate of potash gave an average increase in yield of over two tons per acre. For intermediate quantities, only one season's figures are so far available, but it may be said that the yield has been increased in accordance with the increased quantity of potash applied.

Effect of Phosphates on Maincrop.—Experiments were commenced in 1922 to compare soluble phosphate obtained from superphosphate, against insoluble phosphate obtained from mineral or rock phosphate. The outstanding feature of this experiment was the very small increase obtained from the use of either superphosphate or rock phosphate. In 1922 the quantity of phosphate applied per acre was 6 cwt. of superphosphate and equal amounts of phosphate in the case of the rock phosphates, but in 1923 and later years, plots were dressed with 2 cwt., 4 cwt., and 6 cwt. per acre of superphosphate with No Phosphate plots as controls. In 1923, the No Phosphate, 2 cwt. and 4 cwt. plots gave approximately the same yield. The 6 cwt. plots dropped down ½ ton below the No Phosphate plots. In 1924, the 2 cwt. dressing gave a considerable increase over the No Phosphate. The 4 cwt. and 6 cwt. plots, however, gave no

increase over the 2 cwt. plots. In 1925 the 2 cwt. plots again gave an increase over the No Phosphate, the 4 cwt. plots and 6 cwt. plots giving the same yield as the 2 cwt. plots. The averages of the four years are as follows :—

No phosphate	11 tons	7 cwt.
2 cwt. superphosphate ...	12 „	18 „
4 „ „	12 „	16 „
6 „ „	12 „	7 „

These results are at variance with the accepted methods of manuring of the potato crop, especially in Lincolnshire, where very large quantities of phosphates are applied in compound fertilisers, the quantities thus applied, varying from 8 to 14 cwt. per acre.

One of the effects of applying superphosphate is to encourage early ripening, and it is quite likely that the application of large quantities of phosphates encourage early maturity in the potato, especially in the somewhat dry districts of the eastern counties. It should be clearly understood that similar results would probably not be obtained on black fen soil; on black fen soil it is the custom to apply superphosphate only. Experiments, however, are showing indications that the addition of small quantities of ammonia and potash materially increase the crop on such soils.

Quantities of Manure per Acre.—From the above experiments the following would appear to be a suitable mixture for main-crop potatoes :—3 to 4 cwt. sulphate of ammonia, 2 cwt. super-phosphate, and 2 cwt. sulphate of potash.

Experiments, however, have shown that in a properly balanced compound it is possible to apply very much larger quantities of these manures. Experiments have been carried out during the past three years to ascertain the economic quantity of compound fertiliser which can be applied per acre. The following mixture was used in the experiment :—

2½ parts by weight	sulphate of ammonia.
4 „ „ „	superphosphate.
2 „ „ „	sulphate of potash.
½ „ „ „	steamed bone flour (which was added for the purpose of keeping the mixture dry).

This mixture shows an analysis of 7.5 per cent. ammonia, 12.0 per cent. soluble phosphate, 10.0 per cent. potash. Plots were dressed with this mixture in varying quantities up to one ton per acre with No Manure plots as controls. Remarkably consistent results have been obtained over the three years, the

yield materially increasing as the quantity of artificial was increased. The averages are as follows:—

Manuring.		*Yield.*
No Artificial	...	6 tons 12 cwt. 76 lb.
5 cwt. Artificial	..	8 „ 11 „ 44 „
7½ „ „	...	9 „ 4 „ 66½„
10 „ „	...	10 „ 6 „ 83 „
12½ „ „	...	11 „ 7 „ 21 „
15 „ „	...	11 „ 17 „ 16 „
17½ „ „	...	12 „ 7 „ 96 „
20 „ „	...	12 „ 12 „ — „

It will be noticed that the last 2½ cwt. has only resulted in an increased yield of 5 cwt. per acre. It is advisable in this case to consider the financial returns per acre. If the price of the crop is taken at £5 per ton the following figures of the return per acre are obtained after deducting the cost of the manure at £8 8s. 4d. per ton:—

Manuring.		*Value of Crop.* £	s.	d.
No Artificial	...	33	3	4
5 cwt. Artificial	...	40	14	11
7½ „ „	...	42	19	9
10 „ „	...	47	8	4
12½ „ „	...	51	10	9
15 „ „	...	52	19	7
17½ „ „	...	54	11	8
20 „ „	...	54	12	2

It will be noticed that there is a very definite increase up to and including the 17½ cwt. plots, these plots showing an increased profit of £1 12s. 1d. over the 15 cwt. plots.

If the price of the produce is taken at £3 per ton, a somewhat different result is obtained. The following are the net returns per acre after deducting the cost of the manure:—

Manuring.		*Net return per acre.* £	s.	d.
No Artificial	...	19	17	7
5 cwt Artificial	...	23	11	10
7½ „ „	...	24	10	3
10 „ „	...	26	15	1
12½ „ „	...	28	16	2
15 „ „	...	29	5	1
17½ „ „	...	29	15	8
20 „ „	...	29	8	1

It will be noticed that in this case there is no safe margin of profit above the 12½ cwt. The 15 cwt. plots show an increase of only 8s. 11d. per acre over the 12½ cwt. plots.

A reasonably safe recommendation is probably 15 cwt. of the mixture per acre. In the mixture used this dressing is

equal to applications of $4\frac{1}{8}$ cwt. sulphate of ammonia, $6\frac{3}{8}$ cwt. superphosphate, and $3\frac{1}{3}$ cwt. sulphate of potash per acre.

Combining these results with those obtained in the experiments to ascertain the most suitable quantities of ammonia, phosphate and potash, it would appear that the mixture used in the quantitative trial can be considerably amended, and probably a mixture of 4 parts sulphate of ammonia, 4 parts superphosphate and 3 parts sulphate of potash would give satisfactory results.

Conditions governing the Quantity of Manure to be applied per Acre.—With reference to the application of artificial manure, the economic quantity is undoubtedly governed by the soil and also probably more so, by the cultivation. The potato crop is certainly one which pays for thorough and efficient cultivation and generous treatment, and there is probably a very distinct relationship between the thoroughness of the cultivation and the quantity of compound which can be applied per acre.

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THE MANURING OF POTATOES: TRIALS IN THE NORTH OF ENGLAND.

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WITH the object of obtaining local data as to the manuring of the potato crop, trials have been carried out in Northumberland and Durham since 1921. Only certain aspects of the question have been considered, but, it is hoped that the recorded observations upon the results obtained may contribute useful information bearing on the general question.

It was commonly held that among potash manures sulphate of potash gave the best results both as regards quality and quantity. In 1921, an experiment was instituted to compare different potash manures, and, as a result, it was found that sulphate of potash gave over 2 tons more potatoes per acre than muriate of potash and also that the tubers were of better quality. In 1922 a more elaborate series of experiments was carried out at six different centres. The object was to compare sulphates and chlorides in the form of sulphate of ammonia, chloride of ammonia, sulphate of potash, muriate of potash, kainit, etc. Twenty plots were laid down at each different centre, 10 receiving dung and artificials and 10 receiving artificials alone. The plots were so arranged that the different potash manures were applied with dressings of dung and

nitrogen, or nitrogen alone in four combinations. Where nitrogen was used, it was applied at the rate of 1 cwt. per acre of sulphate of ammonia, or its equivalent as ammonium chloride; and the potash manures were applied at a rate equivalent to 2 cwt. sulphate of potash. In following years, similar plots have been laid down at different centres, except that the number of plots has been reduced to ten, each receiving dung in addition to various dressings of artificials. On all plots, superphosphate was used at the rate of 4 cwt. per acre, except where the land had previously received heavy dressings of phosphates.

The 1922 results showed that dung gave a considerable increase compared with those plots receiving no dung, the average over the whole of the plots being an increase of 2¼ tons per acre. The results indicated that, provided sufficient care was taken to secure uniform application of the dung, reliable comparative results could be obtained between such plots and plots where no dung was used. As the usual practice in the north of England is to apply dung to potatoes, all plots after 1922 received dung and the equivalent of 2 cwt. sulphate of ammonia was substituted for 1 cwt. on those plots receiving dung. It was found that nitrogen alone did not always give an increased yield. Sulphate of ammonia gave results rather better than those obtained with ammonium chloride at four centres, while at two centres ammonium chloride gave slightly better results.

On the whole of the plots since 1921 it has been found that a potash manure has in every case given an increased yield, whether applied with dung or without dung. At some centres the increase has been very marked. At four centres in 1922 all plots dressed with muriate of potash gave a decreased yield compared with the plots receiving sulphate of potash. Where kainit was used the reduction in crop was more marked. At these centres the consistent increase obtained on the different plots by the sulphate compared with the chloride was very marked. Sulphate of potash gave an average increase of about 13 cwt. on sixteen comparable plots. At only one centre was the increase greater on the "no-dung" compared with the dung plots. At the two centres where ammonium chloride gave rather better results than sulphate of ammonia, it was found that muriate of potash and kainit in most cases gave better results than sulphate of potash. At both these centres the soil was of a light, sandy character and the crop was lifted

before it had reached maturity, although considered quite safe for keeping. During the years 1923, 1924 and 1925, sulphate of potash at various centres (eight in number) has given consistently better results than muriate of potash, although in some cases the differences were less marked than in others.

Observations during Growth.—Careful observations were made on the foliage of the different plots during the growing period. On the plots receiving dung, the plants appeared a few days earlier and were slightly stronger than those receiving artificials alone. A point noted particularly in 1922 and 1923 was that the plots receiving sulphate of potash made the strongest growth in the early stages, while those receiving chlorides in the form of muriate of ammonia, muriate of potash or kainit, had the weakest plants. Although the chloride plots did not come on so vigorously in the early stages, after they were about six inches high they made rapid growth and the foliage assumed a dark green appearance. While this green colour was in some cases deeper than on the sulphate plots, the plants had not the same healthy appearance. The foliage of the sulphate plots was evenly balanced while on the chloride plots there was much irregularity in some seasons and the plants lacked uniformity in the drills. This lack of uniformity was specially marked in 1925.

In 1922 it was noted that the potatoes which had received sulphate grew steadily till the end of the season when the plants ripened in the normal way, but those receiving chlorides ceased growth earlier and the foliage turned rapidly dark in colour and died down. This condition has not been noted in all seasons, but apparently if adverse weather conditions prevail, the chloride plots succumb more readily than the sulphate plots.

In most cases it was found that the plots receiving sulphate of potash remained more vigorous in growth for a longer period than those not receiving potash. The comparison with the "no-potash" plots and those receiving muriate or kainit was much more variable in this respect. After the foliage had died down in 1925 there was a marked difference in the appearance of the haulms on the different plots. On the sulphate of potash plots it remained partially erect and was brown in colour, while on the chloride plots it was more laid and had a distinctly bleached appearance. This condition was noted at all three centres.

Many of the results obtained in Jersey and in Ireland are not so definitely in favour of sulphate of potash as compared with muriate of potash, but the results obtained in the north of England would seem to indicate that if potatoes were lifted with a green haulm before the crop has fully matured, the difference in most cases would not be so great as when they are allowed to reach full maturity. This was tested in 1923 when plots at one centre were lifted partly in the third week in August and partly in the first week in October. It was found that the sulphate of potash plots had increased in yield by 17 cwt. per acre in the interim while the muriate of potash plots increased by 12 cwt. per acre and the kainit plots 10 cwt. per acre.

With regard to phosphates, little has been done, as in most cases where trials have been carried out the land had previously received liberal dressing. Where tests have been made in two cases very satisfactory increases have been obtained. A slight decrease resulted in one series by increased applications, but so little that it could scarcely be considered significant. It was interesting to note that the plots receiving in 1925 nitrogen alone showed more abundant foliage than those plots receiving potash and nitrogen. The yield, however, was con-considerably less with the nitrogen alone.

Cooking Tests.—These were carried out by the Northern College of Cookery and others, with potatoes from the various centres, and the following summary report for 1922 is typical of the results obtained in other seasons:—

Manuring.	*Colour.*	*Texture.*	*Flavour.*	*Order of Merit.*
Dung, Sulphate of Ammonia and Muriate of Potash	Poor	Soapy	Poor	Sixth
Dung, Sulphate of Ammonia and Kainit	Poor	Soapy	Bad	Seventh
Dung, Sulphate of Ammonia and Sulphate of Potash	Good	Mealy	Good	First
Dung, Sulphate of Ammonia and Potash of Magnesium Salts ...	Poor	Hard and soapy	Poor	Fourth
Dung and Sulphate of Ammonia	Fairly good	Medium	Poor	Third
Dung, Chloride of Ammonia and Muriate of Potash	Very bad	Soapy	Poor	Eighth
Dung and Chloride of Ammonia	Poor	Soapy	Medium	Fifth
Dung alone	Fairly good	Medium	Fairly good	Second

Variety Tests.—In 1924 and 1925 experiments were conducted to compare varying quantities of artificials and the

response of different varieties to different dressings. While great importance cannot be attached to the results obtained until further tests have been made, the results are quite suggestive.

In 1924 various combinations of sulphate of ammonia and sulphate of potash, up to 4 cwt. of each per acre, were tried on four varieties of potatoes—British Queen, Up-to-Date, King Edward and Great Scot. All varieties showed increases for dressings up to 3 cwt. of each fertiliser per acre, but Great Scot was the only variety to show an appreciable increase with dressings of 4 cwt. of each per acre, there being an increase of 12 cwt. of potatoes per acre compared with the yield on plots where 3 cwt. of each fertiliser had been applied.

In 1925 a similar trial was made except that the maximum dressing was increased to 6 cwt. each of sulphate of ammonia and of sulphate of potash. Majestic was added to the varieties used in 1924. Among the varieties tried in 1924, Great Scot again showed the greatest response to increased applications, while Majestic gave still greater increases.

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THE MANURING OF POTATOES: SUMMARY OF POINTS ARISING AT THE ROTHAMSTED CONFERENCE.

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Importance of the Crop.—The potato crop is increasing in importance in British agriculture although nearly all other arable crops are decreasing in area. In the peak period, 1868 to 1872, when arable farming was at its best, the area under potatoes in Great Britain was 580,000 acres. In 1925 when the whole arable area had fallen very greatly the potato area was 635,000 acres. The first reliable return of yields in 1884 gave the potato crop for the year as 3,740,000 tons; by 1925 this had increased to 4,280,000 tons.

In areas specially suited to it, the progress of the crop has been ever more rapid. In Lincolnshire in 1867 34,300 acres of potatoes were grown while in 1925 the area was returned as 104,000 acres.

Primary Requirements.—The manurial requirements of the crop are determined in the first place by conditions of soil and climate. It is essential that there shall be a good air supply to the roots, that the supply of moisture be adequate and that

the variety of potato cultivated shall be capable of responding to generous treatment.

Disease.—The potato crop is more liable to serious damage by disease than almost any other, and in some respects this tendency is affected by the manuring. Scab is associated with alkaline conditions in the soil, and, in so far as these may be aggravated by manuring, the use of such things as basic slag and lime should be avoided or at least undertaken with due caution. Potato blight is known to be encouraged by excessive use of nitrogenous manures, particularly if this is accompanied by an insufficiency of potash.

Organic Manure.—Farmyard manure, in that it has physical effects in the soil which help the air and water supply to the roots of the plant, remains as the basis of manuring for potatoes. As the supply of it is seldom great enough, more information is wanted concerning the use and possibilities of such substitutes as green crops for ploughing in as organic manure.

Nitrogenous Manures.—The results of a great deal of past experiment at Rothamsted and elsewhere point to the fact that under ordinary circumstances 1 cwt. of sulphate of ammonia will produce an increase of one ton of potatoes.

It is often profitable to use up to 3 cwt. per acre of sulphate of ammonia or some other quickly-acting nitrogenous manure, though the most profitable dressing in any one season must depend upon the price per ton of the potatoes produced.

Phosphatic Manures.—There are many cases where the application of phosphatic manures, notably superphosphate, has produced good results with potatoes. The need for extra phosphate is not so general or so well pronounced as that for nitrogen and potash. In many districts the amount of phosphate used for potatoes is excessive.

Potash.—The general realisation of the need for an ample supply of potash is more or less a recent development. Of the potash fertilisers on the market it has been found that the most expensive form, sulphate of potash, generally produces the best quality tubers. In some cases muriate of potash produces results which both in yield and quality are equal to those obtained with the sulphate. Low grade potash salts of the kainit type have been used with particular success on certain light lands near the sea coast.

Compound Fertilisers.—The results of Lincolnshire experiments show that a mixture of 2½ cwt. sulphate of ammonia,

2 cwt. superphosphate and 1½ cwt. muriate of potash per acre will produce good results with main crop potatoes. For earlies it is often profitable to apply half as much again per acre.

A compound fertiliser consisting of 2½ cwt. sulphate of ammonia, 4 cwt. superphosphate, 2 cwt. muriate of potash and ½ cwt. of steamed bone flour, and giving an analysis of 7.5 per cent. nitrogen, 12 per cent. soluble phosphate and 10 per cent. potash, has been used successfully for main crop potatoes. Dressings of this mixture up to 1 ton per acre have been compared in point of cost and profit with the following general result:—

Price of Potatoes : £5 per ton.
Cost of Manure deducted.

Nil.	*½ ton per acre.*	1 *ton.*
£32 per acre.	£48 per acre.	£54 per acre.

Cultivation Effects.—Manures will not produce their good effects in the absence of proper cultivation. A comparative test, conducted in the north, with dressings ranging from 1 cwt. to 6 cwt. of sulphate of ammonia and muriate of potash, respectively, on land of which only one half had been adequately cultivated gave striking results.

On the poorly cultivated area, hardly any increase was recorded, while on the other half a range of yield of from six to ten tons per acre was found to be correlated with the manuring.

Experimental Method.—Modern experiments in manuring must frequently be of the multiple-factor type, in which all possible combinations of the substances under test are considered. In order to carry out this type of work adequate replication and a well considered lay-out of plots are necessary.

The application of modern statistical methods makes possible an accurate evaluation of the results of experiments which are laid out in a suitable manner, and this increases their usefulness as reliable guides to practice.

The results of similar experiments carried out at different centres are often seemingly contradictory. It is therefore necessary that individual growers should conduct some form of rough local experiment on their own farms before committing themselves to extra outlay on their potato crops.

Balance of Fertilisers.—The balance of the fertiliser constituents in a compound or in the soil has been found to be of equal importance to the gross quantity present.

Both from the point of view of yield and quality and that of ultimate financial return, a medium weight of a complete dressing of artificial fertilisers added to an application of farm yard manure has proved generally satisfactory and reliable.

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AN INTERESTING SMALL HOLDINGS EXPERIMENT.

A PRIVATELY promoted scheme for the creation of small holdings which has aroused more than local interest was put into operation at Winterslow, a small village in Wiltshire. The scheme originated thirty-three years ago, and the unbroken record of success during that period, as well as the satisfactory results that have followed from the experiment, make it opportune, when public attention is being focussed on the question of small holdings, to put on record in the *Journal* some information with regard to the origin and progress of the scheme and its present position.

Winterslow is an isolated and scattered district on the edge of Salisbury Plain, not far from the Hampshire border. It comprises four distinct hamlets (Winterslow, West Winterslow, Middle Winterslow and The Common) with a total population of 784. The nearest market town and railway station is Salisbury, which is eight miles distant. Neither the nature of the soil nor the character of the district can be said to be specially favourable to the creation of small holdings, but the fact that a number of small freeholds had survived from past generations kept alive a certain inherited tradition of enterprise, thrift and independence, while another fact of importance is that the surrounding district is heavily wooded, and for generations Winterslow has been noted for its woodmen, who still cut and convert underwood into sheep hurdles and cribs.

Method of Purchase.—The small holdings scheme was initiated in 1892 by Major Poore, a resident landowner and County Councillor. This gentleman consulted with a number of villagers who were anxious to acquire small areas of land, and the result was that a farm of 189 acres was purchased for £1,500. The farm was of poor quality, mainly arable, and had been indifferently cultivated by the previous occupier with the aid of three labourers, none of whom resided on the farm, there being no cottages attached to it. The land was consequently in a starved and impoverished condition. After selling

Fig. 1.—Cottages on the Winterslow Estate, built before 1914.

Fig. 2.—Another view of Cottages on the Winterslow Estate, built before 1914.

Fig. 3.—A Bungalow on the Winterslow Estate, built since 1918.

Fig. 4.—Another Bungalow on the same Estate, built since 1918.

off 77 acres of unsuitable land for £700, there were left 112 acres which had cost £800, or roughly £7 8s. per acre. The purchase money was provided by means of a bank overdraft guaranteed by Major Poore. The land was divided into 43 holdings, ranging in size from a quarter of an acre to 16 acres, and was re-sold at prices varying from £8 to £30 per acre, with an average over all of £10 per acre. The value of the various plots was fixed by a committee of the prospective purchasers. Those who could not pay cash down were allowed to spread their payments over a period of fifteen years by means of an annuity, including interest at 5 per cent. In order to avoid conveyancing costs leases were granted to plotholders for a term of 2,000 years. This demise continues and frequently leases are surrendered and new leases granted for the full period. The cost of a lease is 2s. 6d. plus stamp duty.

A particularly interesting feature of the scheme is that self-management was instituted at the outset and has been continued ever since. The purchasers were formed into groups, each group sending its chairman and vice-chairman to the "Land Court" over which Major Poore presided. The groups were responsible for the collection of the purchase instalments, while the Land Court looked after the general financial administration of the scheme.

Equipment and Housing.—In 1906, after the whole of the land retained in 1892 had been completely paid for, the Court had to its credit an accumulated profit of nearly £600. This fund was utilised for advancing money for the purpose of equipment, the loans being repayable in fifteen years with interest at 3 per cent.

As the fund accumulated and questions arose relating to the grant of advances for the erection of houses and other purposes, the chairman of the group concerned presented to the Land Court a recommendation, which had to be the unanimous opinion, based on facts only, of the group he represented. The President of the Land Court, acting in the capacity of a High Court Judge, heard any further evidence, and put the case to the other group representatives, who constituted the jury. Their decision also had to be unanimous, and no matters of hearsay or sentiment were allowed to come into the discussion.

Another noteworthy feature is the extent to which the newly created holdings have been provided with dwelling houses. So much is this the case that the scheme might be said to partake more of the nature of a housing scheme than

of a small holdings scheme in the ordinary sense. The district abounds in chalk of a kind that is very suitable for building purposes, and rammed chalk houses have always been a traditional feature of the neighbourhood. Between 1892 and 1914 no fewer than 31 houses were erected by the new small holders, with the aid of loans from Friendly Societies and the funds of the Land Court. Most of these houses are made of the local chalk, and have slated or tiled roofs, and owing to the fact that many of the small holders were able to assist in digging the chalk, as well as in constructing the houses, the average cash cost was only about £125. The accommodation provided is quite sufficient, including generally three, and in some cases four, bedrooms. The houses are comfortable, clean and attractive, and in a good state of repair. The water supply is drawn mainly from rainwater storage tanks. Since 1920, three houses have been built, two at a cost of £600 each and one at a cost of £400.

At the present time there are 52 small holders on the land originally purchased, and these are divided into five groups ranging from 5 to 17 in number. It should be observed that purchasers are not obliged to become group members, but in only one case has a purchaser failed to do so. A sixth group has been created recently in connection with the purchase, in 1920, of 62 acres of additional land, which cost £1,371 and was paid for entirely out of the surplus funds of the Court. This land has been re-sold to 12 small holders (11 of whom already owned land under the scheme) at the rate of £27 per acre. These men paid £586 cash down at the time of purchase, the balance being spread over fifteen years. It was decided to charge interest at only 3 per cent. in view of the depression in agriculture and the fact that most of the land was taken up by men already holding land under the scheme.

Crops and Stock.—The land comprising the Winterslow small holdings is practically all arable, and is typical stonebrash overlying the chalk, probably worth to-day a rent of 20s. per acre if let in a large farm. No attempt is made to carry on intensive cultivation. Straw and root crops are grown and used for the feeding of poultry, pigs and horses, and the general cultivation is about the standard of the district. There is a certain amount of vegetable growing for home consumption, and in some cases the land is highly cultivated where it is used as gardens, either by occupiers of houses built under the Land Court, or by other owners who have been able to purchase additional small areas to add to their own premises.

Poultry appear to be the principal form of live stock, but some pigs are kept, and in a few instances the small holders have one or two cows, which, after the Belgian method, are tethered on temporary pastures.

With one exception (a small holder occupying 15 acres elsewhere) the land is not in any sense the principal means of livelihood of the owners, who include woodmen, labourers, hauliers, the village tradesmen, a blacksmith, a bricklayer, a painter, a retired postman and the sub-postmaster.

Particulars of two typical cases are given:—

Mr. X., a woodman, purchased originally 7½ acres of land upon which he built a house, with money in this case borrowed from a Friendly Society, and kept a few cows. As he got older, and found that his work as a woodman became too exacting, he devoted more time to his holding, which he increased up to 10 acres. He developed a small dairy business, which is now the principal source of milk supply in the village.

When his son, the village carpenter, was married, he was able to purchase a house and half-an-acre of land adjoining his own, for his son's occupation. As his son's family increased, he wished to add an extra bedroom. This he was able to do by means of an advance of £70 made to him by the Land Court.

Mr. Y., a hay trusser and thatcher, originally purchased 1a. 0r. 11p., upon which he built a very useful cottage at a cost of not more than £100, excluding his own labour. To this area he was subsequently able to add 5½ acres which he took over from an owner under the Land Court whose son was going into the police force, and who owing to advancing years desired to give up his responsibilities. Again in 1921, when the additional area was purchased by the Land Court, this holder was able to pay £225 for 7a. 3r. 6p., thus bringing the total area of his holding up to 14a. 1r. 23p.

He keeps a considerable number of pigs and poultry, and about an acre of the land has been turned into a market garden. About 5 to 6 acres of the area is under pasture, while on the remaining arable he grows ordinary crops which he uses for feeding his pigs and poultry, any balance being sold in the ordinary way. He has erected his own outbuildings. He still continues his occupation as a thatcher, and is helped on the holding by his son, who is the local postman, and lives with him. His success is partly due to the fact that he was able to borrow £70 from the Land Court.

In all cases pride of ownership is very marked, and family ties among the small holders are a noticeable feature, as may be shown by the following typical instances:—

1. A woodman, who originally purchased one acre of land upon which he built a very useful cottage. Upon the marriage of his son, who works with him, he built for the son's occupation another cottage close to his own. He had sufficient money for the purpose with the exception of £50, which was lent to him by the Land Court. As a side line, father and son carry on a thriving business in fried fish and ices.

2. A labourer, who originally purchased one acre and built an excellent cottage. His son, the village cobbler, occupies a lean-to shed. He is about to be married and will shortly occupy a house on the scheme left to his mother on the death of her brother.

3. The village newsagent and general store keeper, a lad of 21, owns, opposite his grandfather's house, a small shop, which he was able to build as a result of an advance from the Court.

Apart from the original advances, cases have arisen where improvements and additions to cottages to meet growing families have been possible owing to assistance from the funds of the Court. Since 1892, nine additional holdings have been created on the land originally purchased. This increase is due, principally, to holdings being split up by family arrangement.

It is a remarkable and gratifying fact that, in spite of the numerous and increasing financial transactions of the Land Court and the uncertainties of post-War years, the only loss sustained hitherto is one small sum of £15. The balance sheet for the year 1924 shows assets to the value of £1,222, while in addition there was a sum of approximately £750 still outstanding in connection with the post-War purchase of the 62 acres already mentioned.

The expenses of management are small, and include an honorarium of £10 to the Secretary, and a fee of one guinea paid to the auditor.

The principal reasons for the success of the Winterslow scheme appear to be:—

(1) The excellent system of administration set up by the founder of the scheme;

(2) His foresight, enterprise and wise leadership;

(3) The existence of a local small holdings tradition and a keen desire for land on the part of the resident population;

(4) The availability of cheap land in a most suitable situation;

(5) The special facilities for economical equipment;

(6) The existence of other means of livelihood.

It is significant that Winterslow is the only village in Wiltshire where the population has increased. The moral effect of the scheme has been beyond calculation, and it is not surprising that neighbouring farmers who, at the outset, were opposed to it have now completely changed their attitude.

Given similar conditions there would not seem to be any reason why the Winterslow experiment should not be repeated in other parts of the country with an equal measure of success.

WHEY RESEARCH FACTORY AT HASLINGTON: PIG FEEDING EXPERIMENTS WITH LACTOSE RESIDUES.

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THE activities of the Whey Research factory at Haslington under the direction of a special Committee of University College, Reading, have been primarily devoted to the extraction of lactose or milk sugar from whey.

The method which has been evolved is to concentrate the whey in vacuum at a temperature below the coagulating point of the lactalbumin. The easily crystallisable portion of the sugar is then removed for further purification and the residue is concentrated to a paste, which may be sold in tubs as a food for pigs.

This residue is alternatively further manufactured into a dry food by mixing with brewer's and distiller's grains, after which treatment it is dried.

The paste sets in the containers to the consistency of butter; it is not, however, difficult to handle and may be fed direct to pigs by spreading on boards.

It does not dissolve very readily in cold water, but can be made to do so. It dissolves more readily in warm water. In the experiments reported below, it was weighed out and mixed with the other constituents of the ration in cold water. The whey paste has kept well over a period of seven months and shows no sign of deterioration at the time of writing.

The lactose feed was delivered in bags and has also kept very well. In appearance it is more fibrous than would be expected from the analyses given below; but the fibre determination reveals that this appearance is deceptive, being due to the presence of small lumps of solidified paste.

Analyses revealed considerable differences, more especially in the moisture content of the paste, samples varying from 40 to 53 per cent. The ash was high (10.6 per cent. in the bulk used).

The rations were calculated on an estimated basis of 12 per cent. of digestible protein and 45 per cent. of starch equivalent.

Much more constant results were obtained from analyses of the lactose feed, the figures for which are compared with those of the analysis of the bean meal used in the experiment:—

TABLE 1.

	Lactose Feed.		*Bean Meal.*
	per cent.		per cent.
Moisture	15.03	...	14.16
Fat	4.72	...	0.89
Albuminoids...	19.93	...	21.43
Carbohydrates	43.57	...	53.98
Fibre...	6.81	...	6.51
Ash	9.94	...	3.03
	100.00	...	100.00
Digestible protein taken as...	15	...	19
Starch equivalent	65	...	66

It therefore appeared that the substitution of lactose feed in a ration in place of an equivalent weight of bean meal would offer a means of estimating the feeding value of this substance.

The lactose paste was also in a preliminary short experiment compared with bean meal, but in a later experiment a closer approximation to equivalent nutrients was made by feeding 10 per cent. of lactose paste plus 5 per cent. of bean meal, against 15 per cent. of sharps.

These comparisons were made on 80 pigs arranged in five separate experiments as the animals and accommodation were available from October, 1924, to December, 1925.

Two pork feeding experiments were made with lactose paste and two with lactose feed. In one experiment pigs were carried from the weaning stage to bacon on a diet containing 10 per cent. of lactose feed, as against controls fed on a ration in which 10 per cent. of bean meal replaced the lactose feed.

Bacon Production with Lactose Feed.—It will be most convenient at the outset to describe this bacon feeding experiment in detail, as the other experiments were conducted on similar lines and yielded results which were all in the same direction and closely similar.

For this purpose sixteen Middle White pigs were carefully selected from two litters, and divided into comparable lots of four pigs each—thus making two experimental pens and two control pens. The sexes of the pigs were distributed as evenly as possible throughout the four pens, and each pen contained the same number of pigs from each litter. The boar pigs were castrated. The pigs were weaned between eight and nine weeks old, and for a period of fourteen days afterwards all were

put on one ration in order to ascertain that the relative growth rate of the four pens was approximately similar—that is, that no pen contained a pig or pigs of appreciably stronger or weaker growing strain than the others. Only one pig was found to be unsuitable, and on removal was replaced by a sow pig from a litter farrowed a short time previously to the others; this pig was placed in a control pen, thus making up the full quota of sixteen pigs. The average weight of pig at the commencement of the experiment was 35 lb., and the rations fed for the first few weeks were as follows:—

	Experimental Ration.	*Control Ration.*
Barley meal	45 per cent. ...	45 per cent.
Sharps	30 „ „ ...	30 „ „
Bean meal	15 „ „ ...	25 „ „
Lactose feed	10 „ „ ...	–

The starch equivalent and digestible protein of the two rations were estimated as being, per cent.,

Starch Equivalent	67.5 ...	67.6
Digestible Protein	11.1 ...	11.5

On the fifty-first day of the experiment the rations above were changed to the following:—

	Experimental.	*Control.*
Barley meal	45 per cent. ...	45 per cent.
Sharps	40 „ „ ...	40 „ „
Bean meal	5 „ „ ...	15 „ „
Lactose feed	10 „ „ ...	–
Starch equivalent ...	67.35 per cent. ...	67.45 per cent.
Digestible protein ...	10.40 „ „ ...	10.80 „ „

That is, the bean meal in each ration was reduced by a similar amount; the rations now remained unchanged throughout the remainder of the experiment. The four pens of pigs were taken to bacon weight in from five to six months after the commencement of the experiment. In addition to the meal rations as stated above each pen of pigs received a small amount of green food daily, and as much calcium carbonate as they cared to pick up. The pigs were weighed regularly once a week during the course of the experiment, the weighings always being made soon after the morning meal. The meal rations were fed strictly in accordance with the live weight of the pigs, the endeavour being to supply the pigs with just as much food as they could clear up in from 10 to 15 minutes. The pigs were fed "wet" twice a day (at 8 a.m. and 4.30 p.m.)—the quantity of water being strictly controlled. They were given a small amount of green food, generally in the form of lawn trimmings or cut grass each day at noon; moreover, each pig was allowed about 10 minutes' exercise in an open yard while the pens

were being cleaned out. During the course of the experiment the four pens of pigs " did " very satisfactorily, no pig ever refusing to clear up its allowance of food, and all showing every indication of health and thriftiness.

Figs. 1 and 2 illustrate the growth of the individual pigs in an experimental and a control pen, the duplicate pens being closely similar.

The weights of the four pigs in each lot, and always in the same sequence, are represented by the length of the vertical lines, dates being selected at intervals as space permits; curved lines passing through the upper ends of each in turn of these lines, would as a rule pass through the points indicating intermediate weighings, for the growth of all the pigs was satisfactory.

The lower part of each figure indicates the quantity of food given each day to the group of pigs, the steps indicating the days from the commencement of the experiment on which it was thought necessary to increase the quantity of food. This point was determined as above mentioned by noting the avidity with which the pigs cleaned up their ration and by comparison of the live weights with the recognised requirements of the animals.

The point at which the percentage composition of the ration was changed as mentioned above is indicated by a vertical line.

The upper lines representing the weights of the pigs are situated as nearly as space permits above the quantity of food supplied on the day of weighing.

The results obtained with the duplicate pens comprising eight pigs on lactose feed during the 167 days of the experiment showed that 3.95 lb. of food or 3.39 lb. of dry matter were consumed per pound increase in live weight. The eight pigs fed on bean meal required 4.05 lb. of food or 3.48 lb. of dry matter to produce the same result.

These figures do not include the small quantity of green food fed daily to ensure vitamin sufficiency, nor do they include the mineral matter offered as chalk.

The average gain in weight per pig per day during the experiment was, with lactose feed pigs, 0.97 lb., and with the controls, 0.92 lb.

The percentage dressed dead weight on fasted live weight averaged, with the lactose feed pigs, 73.12, and in the controls, 72.9, agreement between individuals being very close.

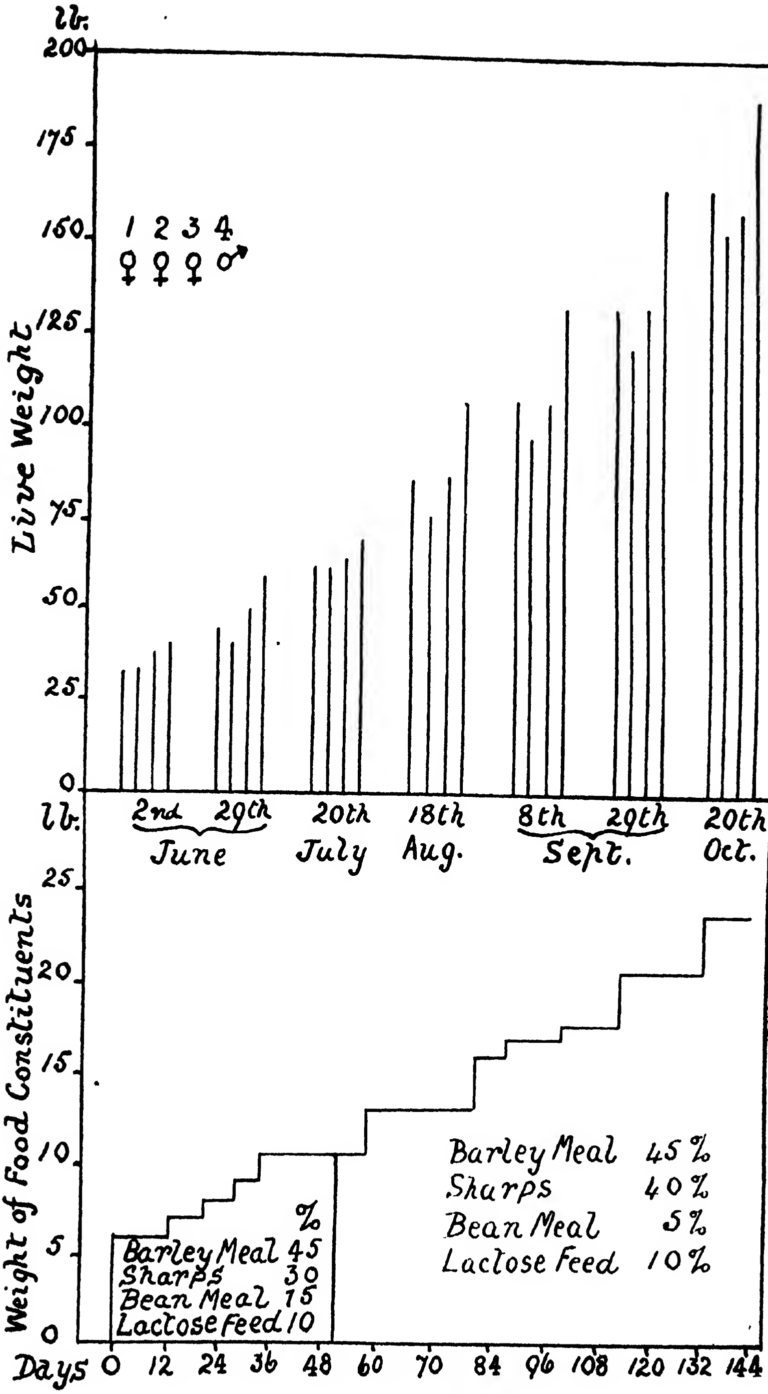

Fig. 1.—Showing the growth of individual Pigs, and Food Consumption of Groups under the Experimental Ration.

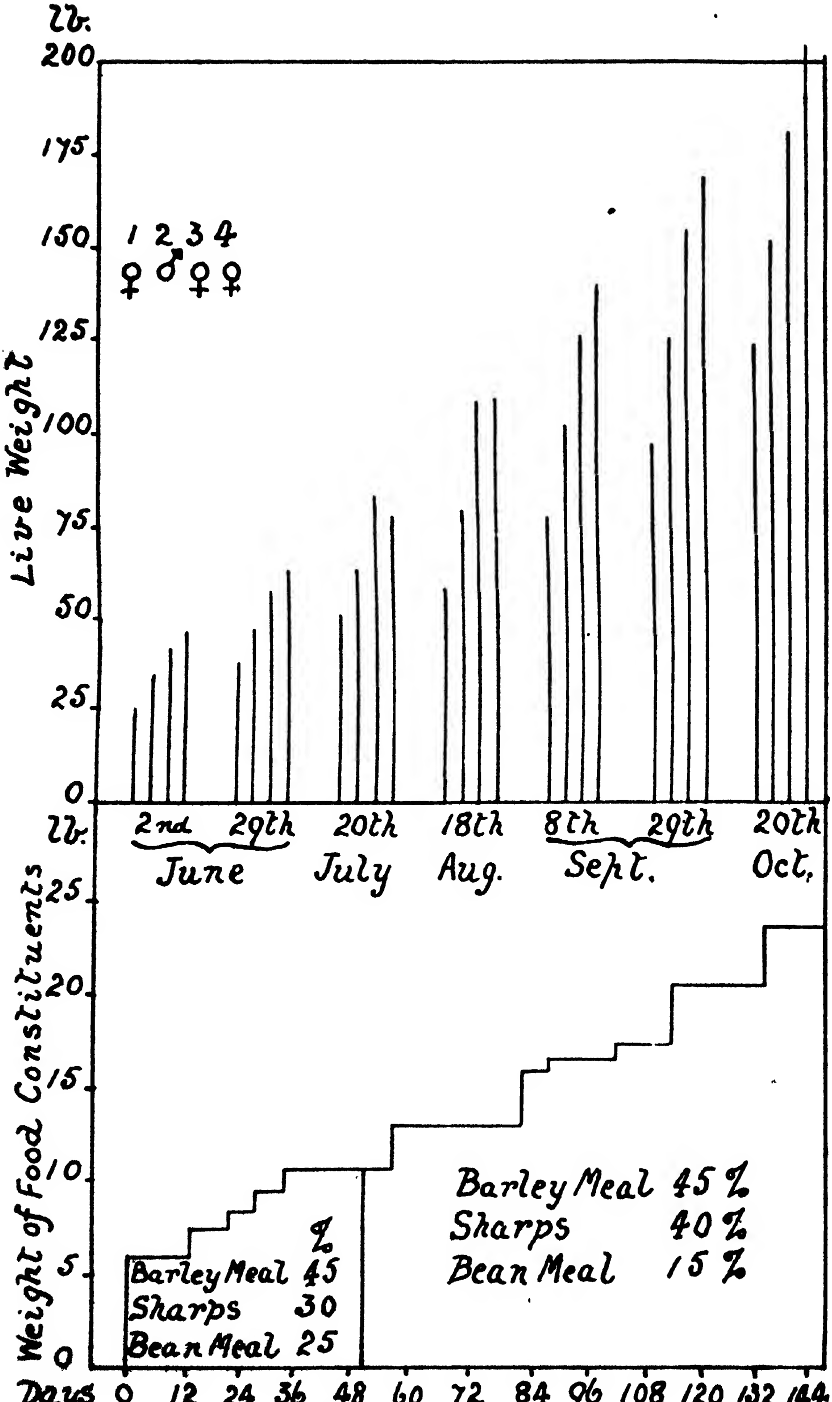

FIG. 2.—Showing the growth of individual Pigs, and Food Consumption of Groups under the Control Ration.

On slaughter all the pigs in both lots fetched top prices, the carcasses being graded first quality, with good streaks, firm fat and a generous proportion of lean meat.

Pork Production with Lactose Feed.—A similar experiment with lactose feed was started on 24th November, 1924, with twelve pigs divided into two comparable lots of six pigs each. This experiment lasted 87 days. The rations consisted of:—

	Experimental.	*Control*
Barley meal	40 per cent.	40 per cent.
Rice meal	20 ,, ,,	20 ,, ,,
Sharps	15 ,, ,,	15 ,, ,,
Meat meal	5 ,, ,,	5 ,, ,,
Bean meal	8 ,, ,,	20 ,, ,,
Lactose feed	12 ,, ,,	—

Green kale and chalk were given in addition. The pigs were taken to pork weight (100 lb. live weight) in about three months.

The food consumed per pound increase in live weight by the pigs given lactose feed was 4.2 lb. (= 3.6 lb. dry matter), by the controls 4.4 lb. (=3.8 lb. dry matter).

These pigs did not grow so well as in the other experiments, the experimental lot gaining, on an average, 0.65 lb. per day, while the controls only gained 0.59 lb. per day.

The value of the lactose feed was, however, further demonstrated.

Lactose Feed for rearing Gilts.—In addition to the above experiments with lactose feed, four gilts were raised on a ration containing 14 per cent. of lactose feed against four controls. The results indicated the suitability of lactose feed for breeding purposes, all the sows appearing to milk well.

Pork Production with Lactose Paste.—Forty-four pigs were used in two experiments with lactose paste.

(1) At the time of the arrival of the product 28 porkers were available for finishing and it was decided to use these as a preliminary experiment although the pigs were nearing 3½ score live weight at the time. The pigs were divided into four even lots of 7 pigs each, two lots being used as a control and two receiving lactose paste.

The control ration was composed as follows:—

Barley meal	40 per cent.
Butter bean meal	20 ,, ,,
Sharps	20 ,, ,,
Rice meal	20 ,, ,,

In addition the pigs were offered 2 lb. green kale per pig per day and 1 oz. each of calcium carbonate and of bone phosphate.

The experimental ration was similar except that 8 oz. of lactose paste replaced 3.6 oz. of bean meal per pig per day.

The results showed that the mean gains in live weight per pig per day during the experimental period were :—

Experimental Pigs.	*Control Pigs.*
1.36 lb.	1.06 lb.

Excluding green food, the food consumed per 1 lb. increase in live weight was :—

Experimental Pigs.	*Control Pigs.*
3 lb.	3.6 lb.

Included in this preliminary work was a small toleration experiment in which three pigs were given up to 25 per cent. of lactose paste, but the gain in weight did not greatly exceed that obtained with the above experimental pigs receiving 8 oz. each per day.

Influenced by this result and by the probable price, we decided to limit experiments to quantities not exceeding 12 per cent., which appeared to be somewhere about the economic limit at the prices then suggested, though there appeared to be no objection to using a larger quantity, if, as has since happened, the price should be reduced.

In this connection it is important to note that quantities of 5 or 10 per cent. seem to be most suitable in a ration for the production of dairy fed pork and bacon.

(2) In a second feeding experiment with this paste sixteen pigs were chosen from two litters and divided, as before, into four comparable lots, making two experimental and two control pens.

Unfortunately the pigs were not a satisfactory lot, and when the experiment commenced on 23rd July last ten of the sixteen pigs at 8½ weeks old did not average 27½ lb. live weight, the remaining six pigs at fourteen weeks averaging only 45 lb. They did not appear pigs likely to " do " well, but as no others were available at the time and there were objections to the buying in of pigs of outside breeding for experimental work, it was decided to carry on with the stock available. The basic ration of meals fed to each pen of four pigs consisted of—

Barley meal	...	...	60 per cent.
Sharps ...	...	...	15 „ „
Bean meal	...	...	5 „ „
Meat meal	...	...	5 „ „

The experimental pens received in addition a further 5 per cent. of bean meal and 10 per cent. of lactose paste, and against

this the control pigs were given an additional 15 per cent. of sharps, so that the full rations were:—

Experimental Pigs.			Control Pigs.		
Barley meal	...	60 per cent.	Barley meal	...	60 per cent.
Sharps ...	...	15 ,, ,,	Sharps ...	...	30 ,, ,,
Bean meal	...	10 ,, ,,	Beal meal	...	5 ,, ,,
Meat meal	...	5 ,, ,,	Meat meal	...	5 ,, ,,
Lactose paste	...	10 ,, ,,			

These rations contain approximately similar nutrients, the experimental ration being slightly richer in digestible protein and the control in starch equivalent. As before, the pigs received a little green food daily and calcium carbonate *ad lib.*; also they were allowed a little exercise in an open yard every forenoon. The pigs were carried to small pork weight (100 lb. live weight) on the above rations in from 3 to 3½ months from the commencement of feeding, the experimental pigs being ready for killing in from 2 to 3 weeks before the controls. The pigs were fed "wet" twice a day, and allowed just sufficient to clear up in from 10-15 minutes.

The mean gains in live weight per pig per day during the experimental period were:—

Experimental Pigs.	*Control Pigs.*
0.77 lb.	0.69 lb.

Excluding green food, the food consumed per 1 lb. increase in live weight was:—

Experimental Pigs.	*Control Pigs.*
3.4 lb.	3.8 lb.

The percentage dressed dead weight on fasted live weight averaged, with lactose paste pigs, 71.4, and in the controls, 71, agreement between individuals being very close.

Practical trials of these food stuffs at other farms in the country agree with the results recorded above.

It would appear that these whey products possess, in common with other by-products from the dairy, some factor or factors which beneficially influence the growth and general well-being of pigs. Such a result is in keeping with the recognised practical advantages of feeding such products as separated milk, buttermilk and whey. We are not in a position at the present time to say to which constituent of these milk products this result is due; but it is hoped in the near future to conduct experiments with a view to ascertaining the exact factor causing these beneficial results.

Conclusions.—The following conclusions may be drawn from the experiments reported above:—

1. The two by-products of lactose manufacture, viz., Lactose Paste and Lactose Feed, evolved by the experiments conducted at Haslington, may both be used with advantage as a food for pigs of all ages.
2. Pigs fed with a ration containing lactose feed required slightly less food to produce 1 lb. increase in live weight than control groups in which equal weights of bean meal replaced the lactose feed. In the case of the lactose paste the inclusion of 10 per cent. in a ration seems to be also an economic proposition, in that quicker growth and better quality are obtained.
3. The general appearance of the pigs was improved by the whey residues, as was also the condition of the pork and bacon produced from pigs fed on these products.
4. At the prices (from £10 to £12 per ton) at which these products were sold a good return might be expected if they are used to the extent of 10 to 12 per cent. of the ration.

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LACTOSE FEED AS A FOOD FOR COWS: A PRELIMINARY EXPERIMENT.

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AN experiment was commenced at mid-day on 25th January, 1925, at the University College Farm, Shinfield, with the object of ascertaining the value of lactose feed when included as part of the concentrates for dairy cows. The lactose feed was produced at the Whey Research Factory at Haslington.

Six cows were taken for the experiment and were divided into two groups, the average yield of each group being 182.9 and 188.1 lb. per week at the beginning of the experiment.

Each group contained two October calvers and one December calver, and each animal in the two groups had received during the early part of the winter the same maintenance ration per 1,000 lb. and the same production ration per gallon of milk.

Concentrated rations were made up as follows :—

						Digestible Protein.
Control Ration :—						
Decorticated cotton seed meal	1 lb.	=	.71 lb.	s.e.	containing	.34 lb.
Maize meal ...	1 lb.	=	.82 lb.	,,	,,	.06 lb.
Bean meal ...	1 lb.	=	.66 lb.	,,	,,	.19 lb.
	3 lb.	=	2.19 lb.			.59 lb.

This ration was fed at the rate of 3 lb. per gal. of milk.

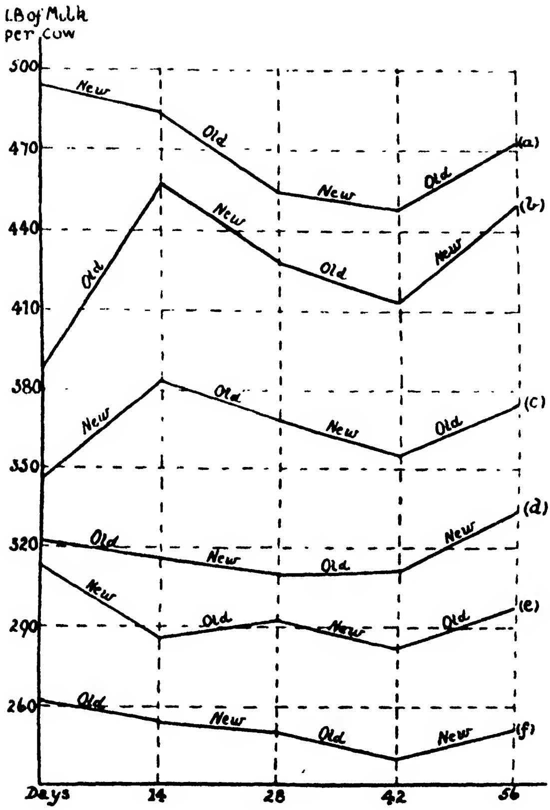

FIG. 1.—Showing the Yields of Milk of each cow in each fortnightly period throughout the eight weeks.

(*a*) Fillpail III, October calver.
(*b*) Strawberry II, December calver.
(*c*) Primrose III, ,, ,,
(*d*) Fillpail VI, October calver.
(*e*) Fillpail IV, ,, ,,
(*f*) Duchess VII, ,, ,,

Old represents the Control Ration.

New ,, Experimental Ration containing Lactose Feed.

Experimental Ration:—						*Digestible Protein*
Decorticated cotton seed meal	1 lb.	=	.71 lb.	s.e.	containing	.34 lb.
Maize meal	1 lb.	=	.82 lb.	„	„	.06 lb.
Bean meal	1 lb.	=	.66 lb.	„	„	.19 lb.
Lactose feed	1 lb.	=	.65 lb.	„	„	.15 lb.
	4 lb.	=	2.84 lb.			.74 lb.

This ration was fed at the rate of 3 lb. per gal. of milk, 3 lb. providing 2.13 lb. starch equivalent containing .55 lb. digestible protein.

It must be pointed out that the above starch equivalent and digestible protein figures of lactose feed are calculated on a purely arbitrary basis. These figures, however, together with those found by chemical analysis appeared to point to the close resemblance lactose feed bears to bean meal.

The experiment lasted for a period of eight weeks, divided into four fortnightly periods.

Group I received the control ration for the first fortnight, and Group II received the experimental ration during the same fortnight, at the end of which Group I was put on to the experimental ration and Group II on to the control.

This completed the first four weeks, after which the work was repeated for a further four weeks.

The yield of the second week in each fortnight after multiplying by 2 was taken as the yield for the fortnight.

Conclusions.—The diagram shows the yield of each cow in each fortnightly period throughout the whole eight weeks.

It will be seen that the yield was not seriously affected either way by the inclusion of lactose feed, from which we are inclined to believe that our assumption of a value similar to bean meal is not altogether unjustified.

The rather noticeable rise in the case of "Strawberry II" and "Primrose III" is no doubt due to the fact that they had not reached their maximum after calving on 24th December and 30th December, respectively, at the time the experiment commenced.

During the second fortnight the whole herd was tuberculin tested, and it is probable that the rather noticeable drop in the case of "Fillpail III," "Strawberry II" and "Primrose III" may be attributed to this operation.

The consistent rise in the case of each cow during the last fortnight is probably due in part to the large amount of grass available during that period, as a result of the very open winter experienced.

Had it been possible to commence the experiment earlier, it was intended to carry the investigation further by substituting lactose feed entirely for the bean meal in the experimental ration.

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A COMPARISON OF SCANDINAVIAN AND BRITISH PIG BREEDING METHODS.

1.—DANISH METHODS.

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EARLY in 1925 the writer was granted a Travelling Research Fellowship by the Ministry of Agriculture for the purpose of investigating the methods employed in Denmark and Sweden to improve the supply of pigs required in those countries to produce bacon for the British markets. Much had been written previously in the agricultural press about these methods, but there was considerable difference of opinion as to whether or not they could be applied to conditions in this country. The position seemed to be very aptly stated by Sir John Russell, in his introduction to Mr. Harald Faber's book "Co-operation in Danish Agriculture," as follows: "In solving our own problem we shall not necessarily use the same model; we are more likely to follow our national bent and improvise or design one adapted to our own special conditions. But the Danish model here described has proved an extremely potent constructive implement, and we shall do well to study it closely."

It is in the spirit of this statement that the result of the investigation and the conclusions drawn from it are put forward in this and two following articles.

Breeding Centres.—When the export of live pigs to Germany was stopped in 1887 owing to the German fear of importing infectious animals, the Danes found that the English market for bacon cured in the Wiltshire way was the only practical outlet for their pigs. For this market their native breed of pig, the Landrace, had not quite the proper conformation, and they were obliged to start altering it in the required direction.

It was soon discovered, apparently by chance, that where the Large White Yorkshire was used to cross with the native pig the result was a very good carcass for bacon curing, and it was not long before boars, bred in the district in which this crossing was first tried, were sent all over Denmark in an attempt to

improve the native Landrace. It is obvious that these boars were hybrids and that their use would therefore produce somewhat chaotic results, and although this was what actually happened, the Danish farmers did not at first understand the difficulty.

The constitution and fecundity of these mongrel pigs, however, were becoming seriously impaired, and in 1895, as the result of an investigation carried out by the Live Stock Commissioner, Mr. Mörkeberg, it was realised that while the first cross between the Large White and the Landrace was apparently the best bacon pig, it was essential that the parents of this cross should themselves be pure-bred for their own breed.

The plan that was adopted in that year, to ensure that a good supply of pure-bred animals of both breeds should be available for the purpose of crossing for bacon, was to establish what are now known as "State-Supported Breeding Centres." A breeding centre is simply a herd of one or other of the two breeds which has been examined by a body of competent judges and passed as being up to the standard required. When a herd has passed this test it is officially designated a "State-Recognised Breeding Centre," and it receives a certain premium from the Government. In order to obtain State recognition the breeding centre must conform to the following conditions:—

It must consist of at least one selected boar and three selected sows either of pure Danish Landrace or pure Large White breed.

(2) It must be under the permanent inspection of a local selection committee consisting of the assistant live stock commissioner for the district and two members representing the National Federation of Co-operative Bacon Factories.

A herd must be under the inspection of the local selection committee for one year before it can be proposed for recognition. If at the end of the year it proves satisfactory it is proposed for recognition by the local selection committee, but the proposal has to be approved by the district committee. A "recognised" centre is inspected several times during each year of recognition by the local committee, and should the conditions under which recognition is given be altered to any appreciable degree in the course of the year, the title of breeding centre can be withdrawn by the district committee on the recommendation of the local committee.

In inspecting pigs for recognition attention is paid to the following points in this order:—

1. Conformation.
2. Fecundity.
3. Thriftiness as shown by food used by offspring at testing station.
4. Quality of bacon as determined at the testing station.

(3) The owner of the centre is only allowed to sell as breeding animals progeny of boars and sows which are selected by the above committee.

(4) The centre has to be inspected twice yearly by a veterinary surgeon. If contagious diseases should occur the sale of breeding animals has to be stopped immediately.

(5) The centre has from every second selected sow to send four pigs of the same litter to the testing station yearly.

(6) The authorisation has to be given by a district committee of three members. The chairman, who is chosen by the Government, is a representative of the bacon factories, and the other two members either represent the bacon factories or the breeders themselves. The secretary of this committee is the assistant live stock commissioner for the district. Authorisation has to be renewed each year.

Until 1912 the State was responsible for supporting the breeding centres, and contributed £2,250 annually towards their upkeep. Till that date the district and local committees consisted mostly of representatives of the farmers' co-operative societies, but since then the Government assistance has been greatly reduced, and it is most significant that it was the National Federation of Co-operative Bacon Factories that took over the responsibility of financing the greater part of the organisation.

For the purposes of this scheme the whole of Denmark is divided into nine districts, and there is an assistant live stock commissioner in each district. It will be seen from the composition of the local and district committees that the Senior Live Stock Commissioner is well represented on both of them, and in practice this leads to great standardisation and continuity in breeding methods. The most recent available figures (September, 1924) show that there are at present 161 centres for Landrace and 32 centres for Large Whites.

Family Herd Books.—It has already been mentioned that the institution and organisation of the breeding centres aimed at providing a supply of pure-bred animals from which first-cross pigs could be bred for bacon. It is not the idea of the Danes, however, that this system should continue indefinitely, and their aim is eventually to improve the Landrace to such an extent that, while maintaining its excellence in hardiness and fecundity it will produce an ideal bacon carcass as well. When this is achieved they will probably allow the Large White Yorkshire to disappear. In the meantime they have to maintain both breeds pure for first-cross purposes.

It is the method of improving the Landrace, therefore, that it is important to study. This method is based on two simple

hypotheses, one of which has long been recognised in this country, and was in fact adopted directly from breeders in this country about 40 years ago; the other is hardly understood except by a few British breeders and is therefore of considerably greater interest here.

The first hypothesis is that a breed of pigs does not consist of a number of absolutely similar animals (it is therefore in the strictest sense not " pure-bred "), but that it is composed of a large number of families or strains each with certain typical individual characteristics which are transmitted more or less regularly in the female line of descent. In setting out to improve a breed, or to alter its general character (as is the case with the Landrace to-day) the method employed is to obtain some analysis of what the characteristics of the different strains are; then to eliminate those strains which do not conform to requirements and to develop those others that do.

The other hypothesis is that in making such an analysis it is necessary to be quite clear as to what really are the characteristics which are wanted, and that in a breeding animal. such as is developed at the breeding centres, the important point is that it should be able above all things to *transmit* the characteristics which are of importance from the point of view of the improver. The criterion, therefore, of whether a pig is sufficiently good to be maintained for breeding or not is the performance of its offspring as regards fecundity, constitution and thriftiness, and not the record of its own performance in these directions.

It follows, then, that under the Danish system information is required about the offspring of State-recognised animals on the points of fecundity, hardiness, suitability of conformation and capacity to lay on flesh for a small amount of food. In order to obtain this information two sets of records are kept.

In the first case, a private register has to be kept at each breeding centre in which particulars of pedigree, services, farrowings, disposals of litters, of brood sows, and boars are recorded. It is interesting to note that though nearly all of the information entered in these books has to be supplied by the breeder, it is the assistant commissioner who actually enters up all records and is responsible for keeping the book up to date. The private registers are called, in Danish, " Family Herd Books," because all records, which are kept on a loose-leaf system, are filed together according to the strain or family which they represent. In the early days a certain number of sows of

good quality were picked out as foundation sows and each given a serial number. The strains at the present day are still referred to by these numbers (in Roman numerals) and a small number at the side of this family number represents the number of generations from the original sow.

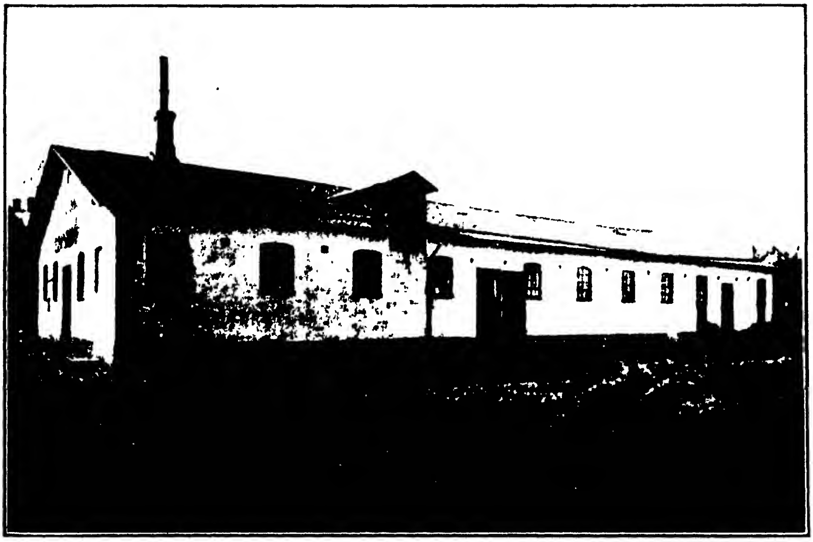
On the sheet for each sow in this record are entered up sufficient details of pedigree to identify it, all services and farrowings, the number of young at each farrowing and the number weaned, the disposal of the offspring, prizes obtained, full description of the animal when mature, and details of the disposal of the sow herself. In effect these private registers (Family Herd Books) take the place of the Breed Herd Book in this country, though they contain rather more information, and also indicate where the breeding performance of the offspring of the sows may be found.

Pig Testing Stations.—The second series of records which are kept in order to determine production capacity of the offspring consist of the reports from the pig testing stations or pig experimental stations as they are called by the Danes. There are three such stations, namely, at Bregentved (Zealand), Elsesminde (Funen) and Over Lojstrup (Jutland).

These stations are under the supervision of a committee of three members, two representing the National Federation of Co-operative Bacon Factories, and one elected by the Government Research Laboratory of the Royal Veterinary and Agricultural College in Copenhagen. They have been instituted in order to obtain information which could not be obtained on the farms at the breeding centres owing to the necessity of having to make numerous careful weighings and measurements of food, live pigs and carcasses.

This is a method rather different from the milk recording of cows, which is done on the farm where the cows are kept, but it is closely analogous to the egg-laying trials which have developed so much recently and in which selected birds are sent from the farm to a central station where all are looked after by independent and trained observers.

As previously stated the owner of a recognised breeding centre must send four pigs of the same litter from every second recognised sow yearly to one of these stations. Each station is under the charge of a member of the Research Laboratory's staff and a joint report is issued yearly or oftener by the Laboratory in which all the details obtained are set out for each litter and total and average results are fully discussed.



Photo] [*Andelsbogtrykkeriet i Odense.*

FIG. 1. Testing Station at Elsesminde, Funen. (Exterior).

Photo] [*Andelsbogtrykkeriet i Odense.*

FIG. 2.—Interior of Testing Station. Showing separate pens for each lot of four pigs, and the individual food tubs for each pen.

The pigs have to be sent to the testing stations at weaning, usually eight weeks old, and the owner is paid the current market value for them as store pigs. They are fed at the station till they reach bacon weight, approximately 200 lb. live weight, and then they are sent to a bacon factory near at hand which pays the station the market value for them as carcasses.

As these pigs come from the best herds they are almost always of a good, thrifty type and pay for their food and labour of feeding. There only remains therefore the cost of extra labour for weighing, recording and general scientific supervision to be met out of grants from the Government and bacon factories.

The tests which are carried out aim at supplying information on the following points:—(1) Economy of food consumption; (2) proportion of carcass to live weight; (3) proportion of cured bacon to carcass; (4) proportion of good cuts in the bacon sides; and (5) natural quality of flesh and fat.

The young pigs on arrival at the testing station are put straight into a fresh pen and are not taken out, except for weighing, till they go to the bacon factory. Each pen is given as much food as it will clear up eagerly. No roots or green fodder are given, and, although the proportions of the ingredients vary according to age, the kind of average meal mixture consists of :—

Ground wheat	1 part	(by weight).	
Ground barley	1 part	,,	,,
Ground maize	1 part	,,	,,
Skim milk (soured)	6 parts	,,	,,

The writer was careful to determine that this was not the typical feeding practised by Danish farmers, as many feed reasonably large quantities of lucerne, potatoes and other roots as well, but in the opinion of Director Hofman Bang, who directs the tests, the above type of feeding is the most economical to employ in Denmark. The cereals mentioned, however, as well as the skim milk, are employed universally, though in varying proportions.

The pigs are weighed every fourteen days and are sent to the bacon factory the day following the weighing day on which they most nearly reach 200 lb. It often occurs that one pig is left in a pen for some weeks after the other three are gone.

The carcasses of the pigs are followed up after they leave the testing station and further information is obtained at

the bacon factory where the loss of weight on slaughtering is obtained, and measurements made of the thickness and distribution of the back fat, the thickness and form of the belly, and the length of "middle" as compared with the gammon and fore end. Points are also awarded for fineness of head, bone and skin. At a later stage still, when the sides have finally been cured, they are examined by the research representative and the bacon factory manager, and marks are given for the following points of quality:—

Firmness of flesh.
Shoulder.
Shape and fulness of ham.
Fulness of flesh.

From the amount of food consumed and the gain in weight from weaning to slaughter, the amount of food units required to give a live weight gain of 1 lb. can be calculated. All the information collected by the testing station authorities is tabulated and issued in the form of a report, which one finds is studied with great interest by owners of breeding centres and by bacon factory managers.

National Herd Book.—It will be seen from the three preceding sections that the only source from which a Danish farmer can get pure-bred pigs of either breed is the breeding centre, and that a selective control is maintained over these centres by the joint action of the Government; the bacon factories, and the agricultural societies, who base their selection decisions on records of pedigree, fecundity, constitution, and breeding qualities obtained from the private herd registers, and on records of thriftiness, conformation, and quality of flesh obtained from the testing stations.

As already mentioned, however, the leaders of the pig industry are aiming not merely at providing pure-bred pigs for first-cross purposes, but at isolating and improving the better strains so as eventually to achieve a different type of native pig. While, therefore, the pigs at the recognised breeding centres are officially authorised as pure bred, steps are taken to find out which of them are showing signs of improvement in the required direction. No subsidy is given for the better class of pig, but the advertisement value of the public recognition is in itself a great incentive to breeders.

Full particulars of these high quality animals are published annually in the National Herd Book, which is edited by the senior Live Stock Commissioner. It will be seen, then, that

the National Herd Book is an advanced register into which only animals which have already been registered in the private herd registers as being of pure descent, may be advanced on account of their higher, tested value.

The annual selection of animals to go into the National Herd Book is made by the senior Live Stock Commissioner, and is based on the private registers and the reports of the testing stations in addition to a certain amount of personal observation at the State shows.

Leaving out of consideration several lists of names of herds, pigs, breeders and owners, the important sections of the herd book are as follows:—

(1) References to the testing station reports in which the test number of each pig in the National Herd Book is given.

(2) Supplementary information on fecundity and prizes obtained by sows which have died during the previous year.

Sows are not usually entered in the National Herd Book until they have had one or two litters, so that something of their breeding performance is known. There is not room in the herd book to enter a sow more than once, and, as it is considered of great importance to know the full record of a sow for the whole of her life, any breeding information, in addition to what was originally entered, is compiled in this section of the book. A typical entry for a very good sow is given below taken from the herd book for 1925:—

Herd Book No.	Name of sow and date of birth.	Litters and prizes after original entry in Herd Book.	Died.
3,414	Lindencrone No. 18. b. 5/9/1913	15/6/1915: 7(7); 27/11/1915: 14(10); 22/5/1916: 11(6); 20/11/1916: 11(9); 21/5/1917: 2(1); 19/10/1917: 19(11); 9/4/1918: 8(8); 2/10/1918: 13(9); 26/4/1919: 14(10); 8/11/1919: 15(10); 30/7/1920: 15(7); 25/2/1921: 15. 1st Prize and Champ. 1917, 1919 and 1920 at State Show. Champ. 1920 Zealand Joint Show.	14/9/1921

The dates of farrowing are given followed by the number born in each case, and the number weaned is shown in brackets.

(3) Entries for:—

Boars—Landrace.
,, Large White Yorkshire.
Sows—Landrace.
,, Large White Yorkshire.

The following is a typical entry for a sow, also from the herd book for 1925 :—

No. 8070. IV.10.
Sow Udstrup No. 1, born 11th December, 1920.

BREEDER : (Occupying owner) P. A. Foged Soesmerk near Guldberg, Lolland.

OWNER : (Tenant) P. Sörensen, Udstrup near Merlöse, Holbæck County.

DESCRIPTION : by K.M.J. 25/6/1923, medium sized, typical, well-built sow with good depth and breadth, medium length, with small, full neck, broad stylish quarters, good hams, fine well-placed limbs. Typical head, but rather high forehead, good ears—14 teats. Litters—26/10/1921 : 10(7) ; 31/3/1922 : 8(8) ; 19/8/1922 : 9 (9) ; 20/1/1923 : 10(10) ; 29/6/1923 : 11(9) ; 22/1/1924 : 10(8).

PEDIGREE.

Sire—Asbjörn Soesmarke, born 1st April, 1919, Reg. No. 1491.
Dam—Soesmark No. 6, born 27th February, 1919, Reg. No. 6018.

OFFSPRING.

The following are well-known offspring :—
Sow Udstrup No. 4, born 26/10/1921, Reg. No. 8082.
Sow Udstrup No. 5, born 26/10/1921, Reg. No. 8084.

Pig Breeding Associations.—In 1899 the State started to subsidize pig breeding associations and in 1909 there were 250 such associations with a total of 326 boars. At that time the subsidy amounted to about £900 per year. In 1912 the State increased the number and severity of the regulations and since then the associations have almost disappeared. Their general organisation was similar to British boar societies and to the boar societies of Sweden to be described in the next article.

State-Supported Shows.—In addition to many agricultural shows organised by farmers' associations a certain number are organised and supported by the Government. At these shows two sets of prizes are given in each class and the values of the prizes are equal in both cases. One lot of prizes is given for conformation of the exhibited animal itself, and the other for pedigree and production capacity.

In the latter case points are awarded as follows :—

40 for prizes awarded to the animal's ancestors for conformation.
40 for the average number of pigs in a litter.
20 for the results of offspring at testing stations.

In this way public attention is directed towards the capacity of an animal to breed commercially valuable offspring, and farmers are encouraged to study the testing station reports.

TRIALS OF THE CROPPING CAPACITIES OF POTATOES.

THE selection of varieties of potatoes for planting next spring will shortly exercise the minds of potato growers. The choice must be influenced largely by the grower's own experience and his knowledge of the soil on which he proposes to grow this crop, but the following account of a series of trials arranged by the Ministry and carried out for several years in practically every county in England and Wales, may be helpful.

The great importance of the potato crop in this country, and the evident need for more information concerning the cropping capacities of the different varieties of potatoes and the best method of cultivation, led the Ministry, with the co-operation of County Education Committees, to institute in 1920 a series of co-ordinated trials throughout England and Wales. Reports of the trials carried out in that year and in 1921 were published in this *Journal* in July, 1921, and May, 1922, respectively. The trials were continued in subsequent years, but in the absence of new varieties of sufficient merit the scheme has now been discontinued.

The seed potatoes used for the purposes of the trials in 1920 and 1921 were obtained through the normal trade channels. and whilst every effort was made to supply healthy seed, it was felt that the comparative value of future trials would be greatly enhanced if the seed potatoes required could be grown on the same land under similar cultural conditions. Accordingly, in the spring of 1921, arrangements were made whereby specially selected seed of the varieties chosen for trial were grown under contract in a locality in East Ross-shire. a far-north district free from wart disease, where potato blight is seldom severe and leaf curl is not common. Whilst growing, the crops were "rogued" and all weakly plants and plants affected with leaf curl and mosaic were removed under the direction of one of the Ministry's Inspectors. The resultant seed potatoes were distributed to Local Education Authorities for the purpose of the trials in 1922. Similar arrangements were made for the supply of seed potatoes for trials in 1923 and 1924.

The particular objects of these trials were to demonstrate (*a*) the cropping capacity of the newer immune varieties; (*b*) the advantages of an adequate system of manuring; and also (*c*) the values of using "seed" from healthy stocks.

Conditions of Trials.—As a correct interpretation of the results of such trials is possible only if the tests are carried out on uniform lines, the Local Education Authorities co-operating in the trials were asked to adhere closely to the following instructions regarding the cultivation of the potatoes :—

(1) *Manures:* A dressing of farmyard manure at the rate of about 15 tons per acre, and the following artificial manures :—

Superphosphate (30 per cent)	... ...	4 cwt. per acre
Sulphate of Ammonia	... ...	1 " " "
Sulphate of Potash (50 per cent Potash)		1 " " "

(2) *Planting:* A distance of 30 in. (amended for the 1923 and 1924 trials to 27 in.) between the drills and 12 in. between the sets.

The varieties selected for trial in 1922 were as follows :—

Immune Ashleaf	Arran Comrade	Bishop
Dargill Early	Kerr's Pink	Irish Chieftain
Ally	Majestic	Rhoderick Dhu
Great Scot	Tinwald Perfection	

For the 1923 trials the same varieties were selected with the addition of the newer introduction " Crusader " and—for the purposes of comparison—the three well-known susceptible varieties " Arran Chief," " King Edward " and " Up-to-date." To these were added in the 1924 trials the varieties " Katie Glover," a new immune variety, " Sharpe's Express " and " Epicure."

Cropping Results.—The potato crop of this country in 1922 was a record one, and it is not surprising that the yields on the trial plots in that year were uniformly heavier than those obtained in other years. In the case of the main crop varieties under trial the difference in yields was on the whole about 2 tons. In 1922 and 1923 the best results were given on medium soils; yields on heavy soils were, with few exceptions, greater than those on light soils in 1922 whilst the opposite effect was recorded in 1923. In 1924 the greatest yields were obtained from light soils. It may be of interest to compare these results with those obtained in previous trials :—

	Greatest Yields.	*Smallest Yields.*
1920	Light soils	Heavy soils
1921	Heavy soils	Light soils
1922	Medium soils	Light soils
1923	Medium soils	Heavy soils
1924	Light soils	Heavy soils

The experimental error involved in any one of these tests is too large to allow definite conclusions to be drawn; but by repeating the trials at a number of centres for several years (as has been done) it becomes possible to compare the cropping capacity of one variety with another where the results show significant differences.

Of the first early varieties under trial "Immune Ashleaf" gave yields somewhat in advance of "Dargill Early" on all soils, but appreciably below the returns given by the susceptible varieties, "Sharpe's Express" and "Epicure." As regards the second early varieties, there was little difference between the cropping capacities of "Great Scot" and "Arran Comrade," though both gave, except in 1924, somewhat larger crops than "Ally." Of the main crop varieties "Kerr's Pink" was first in 1922 and again in 1924 and a close second in 1923. "Rhoderic Dhu" was next to "Kerr's Pink" in 1922 and 1923, but failed to maintain its position in 1924. The cropping capacities of "Tinwald Perfection," "Irish Chieftain" and "Majestic" appeared to be about the same in 1922 (13.5 tons per acre) and in 1923 (11 tons per acre), but there was considerable variation between their yields in 1924. "Bishop" gave the lightest crops throughout.

For purpose of reference the final results of the trials carried out yearly since 1920 are given in the following table :—

Variety.	Average yields in tons per acre.				
	1920	1921	1922	1923	1924
First Early.					
(a) Immune.					
Immune Ashleaf	—	5·6	10·5	8·6	8 7
Dargill Early	7·8	5·0	9·5	7 9	8·5
(b) Susceptible.					
Epicure	—	—	—	—	11·0
Sharpe's	—	—	—	—	10·4
Second Early.					
Arran Comrade	11·4	9·0	14·5	11·8	12·1
Great Scot	11·6	10·5	15·0	11·4	12 0
Ally	—	8·7	14·0	9·8	12·6
Katie Glover	—	—	—	—	9·4
Main Crop.					
(a) Immune.					
Kerr's Pink	13·1	11·4	15·1	12·8	13·7
Irish Chieftain	—	—	13·8	10·9	13·3
Majestic	10·3	9·3	13·4	10·9	12·5
Tinwald Perfection	10·0	8·6	13·3	11·1	11·9
Rhoderic Dhu	—	—	14·5	11·9	11·0
Crusader	—	—	—	10·7	11·1
Bishop	—	—	11·7	10·1	9 0
(b) Susceptible.					
Up-to-Date	—	—	—	13·1	12·2
Arran Chief	—	—	—	11·9	12·6
King Edward	—	—	—	11·8	11·2

Trials with Cut and Whole Sets of Potatoes.—In addition to the variety trials which were carried out at the County Potato Demonstration Plots, comparative trials were undertaken in a few counties with regard to the use of cut and whole sets of potatoes as seed. Experiments carried out by Professor Priestley, of the Leeds University, showed that if the cut sets of the potato are kept in a moist atmosphere, they will develop a corky layer across the wound which prevents—or helps to prevent—the entry of bacteria and fungi. Cut sets which have formed such a protective layer usually grow normally when planted. If, however, the cut sets are exposed to bright sunlight and to the drying action of the winds, the cells dry up too quickly and the formation of suberin is incomplete. Bacteria and fungi can easily enter, and the sets when planted usually fail to grow. These experiments had only been carried out in the vicinity of Leeds, and it was considered desirable therefore that tests should be undertaken in other parts of the country. The results of these tests were forwarded to Professor Priestley, who reported as follows :—

"A brief review of these data shows that whilst with few exceptions sets cut and kept protected from sun and drying wind have given better yields than sets cut and left exposed for a few hours in the sun and dry air, there are no experiments which suggest that sets cut and so protected are more liable to misses than whole sets.

"On the other hand sets left in a dry condition frequently show a high proportion of misses, and in some cases when they do so, the yield per plant in cases where growth takes place, is lower than the yield per plant from cut protected sets.

"On the whole, examination of these experimental results strongly supports the conclusion reached previously on other grounds that, quite apart from yield, the certainty of growth from cut sets is much greater if precautions are taken as to how the sets are cut and left."

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COUNCIL OF AGRICULTURE FOR ENGLAND.

THE 19th Meeting of the Council was held on 10th December, 1925, at the Middlesex Guildhall, Westminster, *Mr. James Donaldson* in the Chair.

Appointment of Agricultural Advisory Committee.—At the Preliminary Meeting of the Minister's Members to elect a repre-

sentative of Agricultural Education and Research on the Agricultural Advisory Committee for England and Wales, in place of Professor T. B. Wood, C.B.E., F.R.S., retired, *Mr. A. W. Ashby, M.A.*, was elected.

Statement by the Chairman.—In opening the proceedings of the Council, *The Chairman* referred to the great loss which the Royal Family and the English people had sustained through the death of Queen Alexandra. He then referred to the change which had taken place in Ministers of Agriculture. He was sure that the best wishes of the Council would go out to Mr. Wood in the responsible duties he had been called upon to undertake. Kindly in disposition, courteous in manner, a gentleman by nature, Mr. Wood had rapidly gained the affection and esteem of the Council. *The Chairman* proposed that they should pass the following resolution:—

> "That the Council of Agriculture for England desire very heartily to congratulate the Rt. Hon. Edward Wood, late Minister of Agriculture, on his appointment as Viceroy Designate of India. At the same time they wish to place on record their high appreciation of the very able and courteous manner in which he has at all times during his tenure of office as Minister of Agriculture met them in the discussion of agricultural affairs. The Council wish him a like success in his new sphere of duty to the Empire."

The resolution was seconded by the *Rt. Hon. F. D. Acland*, Chairman of the Standing Committee, and carried unanimously. *The Chairman* then introduced the new Minister of Agriculture, *the Rt. Hon. Walter Guinness, M.P.*

Statement by the Minister of Agriculture.—*Mr. Guinness*, in the course of his address, said that he was delighted to have an opportunity so early during his term of office of meeting the Council. He took office at a moment of considerable anxiety in agriculture, though he did not think that there was really any occasion for despair. He then referred to the fall in agricultural prices which had been accompanied by a drop in costs. He was sure that the Council would not expect at this early stage any exposition from him of agricultural policy; still he wished from the outset to deprecate the idea that Government policy must be associated with the extraction of the maximum amount of public money for this or for that industry. The aim should rather be to do more satisfactorily what was being done with less success at the present time. He instanced co-operative marketing and agricultural co-operation generally. In recent months the Government had done a good deal to reduce the burdens of agricultural rating and something would

be done in the Tithe Bill also to reduce rating burdens. *The Minister* then referred to the proposed amendment of the Land Settlement (Facilities) Act, 1919, which would assist local authorities in respect of small holdings.

As to foot-and-mouth disease, the position was certainly better than when the Council last met. There had been a progressive decline in outbreaks during the last six weeks. The figures for each week were respectively 65, 34, 22, 19, 20 and 15, and appeared to justify the stringent regulations which had been imposed. A comparison with the situation on the continent showed that in the month of October, France had 3,217 outbreaks; Holland 4,307; and Denmark in the month of September 3,658. These figures should be compared with 76 in the last four weeks in this country. *Mr. Guinness* said that the agricultural community had shown very great patience with the restrictions and he was fully aware of the inconvenience that the partial Standstill Order must have caused in the Midlands and the South. He was, however, quite sure that the slaughter policy could not be maintained unless every step were taken to make it effective. Towards this object, the Packing Materials Order, which prohibited the contact with animals of hay and straw used as packing materials for goods from abroad, had been passed. Research was also proceeding as rapidly as possible with a view to finding a preventive to the disease.

In accordance with a promise which the late Minister of Agriculture had made to the last Meeting of the Council, *Mr. Guinness* said that the rents charged for new houses in rural districts erected under the recent Housing Acts in places which were not able to qualify for the subsidies under Sub-section (2) of Section 2 of the 1924 Act were 4s. to 9s. per week. In addition to the 69,000 houses built under the Housing Acts, 53,000 houses, mainly working-class type, had been built by private enterprise in rural districts in the 2½ years ended 31st March last. Some of the rents were no doubt beyond the means of agricultural workers, but the houses in respect of which they were paid would benefit agricultural workers by freeing cheaper houses. In regard to the fees charged to County Councils for certificates under the Rent Restrictions Act, the Ministry had issued a circular to County Councils on the lines of the suggestions made at the last meeting of the Council, asking them to reconsider the fees in the light of the Council's criticisms.

Mr. Acland asked when the Council would be consulted in regard to the suggestions which were now being put before

County Councils as to small holdings. *The Minister* said that the County Councils had been asked for a reply within the next two months and he hoped a Report could be made to the next Meeting of the Council. *Mr. Acland* also asked whether any steps would be taken to regularise the fees charged under the Agricultural Holdings Acts. Would the Minister inform them at a later Meeting of the Council whether any legislation in this direction was to be proposed? *Mr. Woodhead* raised the question of the restrictions on movement of cattle from the North Riding to the Ripon Fat Stock Show, which was within a regulated area. *The Minister* said that he recognised the hardship to many farmers through these shows being closed to them when they were in the position that Ripon was in. The reason for restricting the influx of animals from outside the areas was that it was not fair to those within the areas who could not move their cattle outside. *Sir Douglas Newton, M.P.* (Cambs) referred to the recent case in which foreign fruit sprayed with arsenical spray had been found to have retained the poison upon it when sold in our markets, and suggested that the sale of fruit generally might be prejudiced by this case. *The Minister* said that the question was really one for the Health Authorities, but that there was no kind of evidence existing of danger arising in this country from spraying fruit. As to the case in question, it was an exceptional matter and in no way reflected on the safety of British fruit. *Capt. Morris* (Herts) proposed a hearty vote of thanks to the Minister for his address, which was carried unanimously.

Sheep Scab Policy.—*Mr. Acland,* Chairman of the Standing Committee of the Council, moved the adoption of the Report from that Committee on the question of the Ministry's proposals in regard to future sheep scab Policy. The Committee supported the proposal as a measure to be applied to the whole of Great Britain, though it was informed that strong objection had come from many of the local authorities and certain of the agricultural organisations in Scotland. The Committee hoped that the objecting authorities in that country would reconsider the matter and see their way to submit to the necessary and regrettable inconvenience and difficulty, in order to stamp out the disease, and that they would recognise that only by a general agreement in the course proposed was sheep scab likely to be quickly eradicated from the country. Should, however, the Ministry ultimately decide that Scotland, or a part of it, must be excepted from the operation of the Order, then the Committee suggested

that the local authorities of the remainder of the country should be permitted to retain power to require double-dipping of all sheep from areas outside their borders which do not come under the Ministry's suggested regulations, before such sheep were allowed within them. *Mr. Denton Woodhead* said he thought it very important that Scotland should come into line in this matter. An Order had been in operation about 1907 requiring double-dipping in Scotland and the North of England, which had been successful in keeping sheep scab out of Yorkshire. *Mr. R. W. Hall* (Hereford) supported the Report strongly on behalf of Herefordshire. *Mr. T. Lovell* raised the point as to the length of time during which sheep should stay in a dip. He had seen sheep dipped much too quickly for the dip to be effective. *Mr. Clement Smith* (East Suffolk) raised the point about the period of dipping. In his part of the country it would, he said, be inconvenient having to begin on the 15th July and finish on the 31st August. The period should be extended and varied to suit different parts of the country. After some discussion, in which *Mr. Denton Woodhead, Mr. R. W. Hall, Mr. T. Lovell* and *Mr. Clement Smith* joined, the Report was adopted. *The Minister* said that he appreciated the assistance which the Council were giving in this matter, and the points raised by the speakers would be considered.

Grant of £1,000,000 for Empire Marketing.—*Mr. Acland* moved the adoption of the Standing Committee's Report on the proposed grant of £1,000,000 per annum to assist the marketing of Empire produce in this country. The Standing Committee stated that it had considered the position in its relation to Home agriculture, and it recommended that representation for British agriculture should be given on any commission or body which might be appointed to decide the allocation and expenditure of the Grant, and that, further, before any expenditure was embarked upon, the Council of Agriculture should be given an opportunity of considering the general proposals with a view to assisting in safeguarding the interests of home producers.

Mr. G. Dallas spoke of the great importance of British interests being safeguarded in this matter. *The Minister* assured the Council that the Government would give the recommendation in this Report most earnest and careful consideration before anything was settled. He added that there was no question at the

moment of spending any large sum of money. The expenditure had first to be negotiated with the Dominions and the interests concerned in this country and voted by Parliament. He agreed with Mr. Dallas as to the importance of the subject. *Mr. W. McCracken* (Cheshire) and *Mr. Clement Smith* also spoke, and the Report was adopted.

Foot-and-Mouth Disease and Importations of Infected Material.—*Mr. Acland* moved the adoption of the Report of the Standing Committee on the recent measures taken by the Ministry to minimise the risk of the introduction of foot-and-mouth disease from the Continent, in which the suggestion was made that bags used in the carriage of potatoes or other agricultural produce imported from abroad should be added to the list of materials mentioned in the Order which were not to be allowed to come into contact with any animals in Great Britain. *Mr. T. W. Atkinson* (Kesteven), *Mr. J. T. Briggs* (Soke of Peterborough), *Mr. R. W. Hall*, *Mr. J. R. Spraggon* (Durham), *Mr. R. L. Walker* (West Riding) and *Mr. A. Matthews* (Hereford) spoke to the motion, and *The Minister* promised that all suggestions made with a view to assisting in keeping the disease out of the country would be carefully considered, but the Ministry did not want to make regulations which could not be enforced. There would be about sixty of our staple industries dislocated if we forbade the importation of packing materials generally. The Report was adopted.

Compulsory Registration of Bulls.—*Mr. Acland*, on behalf of the Standing Committee, moved the following resolution :—

> "That the Ministry of Agriculture be urged to proceed with a Draft Bill for the Compulsory Registration of Bulls on the lines of the scheme which has been placed by the Ministry before the Agricultural Advisory Committee for England and Wales. The Council understands that a somewhat similar scheme has been in operation in Northern Ireland under the Livestock Breeding Act (Northern Ireland), 1922, since 1st January, 1924, and that it is successfully achieving its purpose. The Council recommends that a suitable time (at least two years) should be allowed to elapse between the passing of the Act and the date of its enforcement, widespread notice of the effect of the Act being given in the meantime."

In support of the resolution, he referred to the Report which had been circulated to the Council and to the Draft Bill which was to be considered by the Agricultural Advisory Committee. *Mr. Denton Woodhead* seconded the resolution. *Mr. A. R. White* (Wilts) said he could not support the proposal. He realised the importance of using good bulls, but he was strongly opposed to compulsion. The Wilts Agricultural Committee was

also opposed to the proposal, as were the Wilts Branch of the National Farmers' Union. *Mr. McCracken* also opposed the measure, saying that he did so on behalf of many Cheshire farmers with whom he had spoken. *Mr. T. Warner Turner* (Notts) strongly supported the resolution, as did *Sir Merrik Burrell* (West Sussex), who said that there was no truth in the idea that the breed societies were behind the movement. He himself brought the matter before the Council of Agriculture some years ago. Neither he nor anybody supporting him had in mind that anyone should be forced to use a pedigree bull. In the first place, there would not be enough pedigree bulls to go round and secondly there was no need for anything so drastic. The object of the proposal was not that everyone should have a very good bull, but that no one should have a very bad one. There was great difficulty at present in getting good calves, and there was an excellent market every time a good one appeared. The dairyman who sometimes had the very best of cows used a scrub bull, which practice should be put an end to. The agricultural societies and the branch of the Farmers' Union in Sussex were anxious for the Bill to be proceeded with. *Mr. George Edwards* said that he would have thought that farmers would have tumbled over one another to support a resolution of this kind. He did not understand the reasons for objection. He strongly supported the resolution. *Mr. J. Hamilton* (Lancs) also supported the resolution and said that his Agricultural Committee in 1921 sent a scheme of this kind to the Ministry. Any other scheme than a compulsory one would be of no benefit whatever. *Mr. John Evens* also supported the measure and said that no money that the Ministry had spent had done so much good as that employed on the Livestock Improvement Scheme. *Lord Bledisloe*, Parliamentary Secretary to the Ministry, said that he had warmly supported Sir Merrik Burrell when he first brought the motion before the Council. The desire of the Ministry was rather to be ahead of public opinion than lagging reluctantly behind it. The bull was more than half the herd, and the improvement, if it was to be effective, must begin with the male stock. The general outline of the Bill, which had already been drafted and had come before the Agricultural Advisory Committee on the previous day, is that a date shall be fixed for its operation, *i.e.*, 2 years hence, that it will not apply in the first place to older animals, but only the younger bulls, and that there should be a licensing fee of 5s. per animal. This fee would be paid once only in the life of a

bull, there would be proper inspection, and provision would be made for appeal by anyone who felt aggrieved. *The Chairman* read a letter which had been received from the Agricultural Committee of the North Riding of Yorks, opposing the Bill. The resolution was then put to the meeting and carried.

Re-election of Standing Committee.—The Standing Committee of the Council:—Consisting of the Rt. Hon. F. D. Acland, Lieut.-Col. Sir Merrik R. Burrell, Bart., C.B.E., J.P., Major Fawkes, Sir Arthur G. Hazlerigg, Bart., Sir Douglas Newton, K.B.E., M.P., representing owners of agricultural land; James Donaldson, Esq. (*ex-officio* as Chairman), Wm. Knight, Esq., James Hamilton, Esq., J.P., R. G. Patterson, Esq., C. C. Smith, Esq., Capt. E. T. Morris, J.P., representing tenants; George Edwards, Esq., Denton Woodhead, Esq., A. W. Ashby, Esq., George Dallas, Esq., and Lady Mabel Smith, representing workers, was re-elected.

Plans of Field Drains.—*The Earl of Chichester* (East Sussex) moved:—

"That the Ministry of Agriculture and Fisheries be asked to introduce legislation making it compulsory in all future cases where agricultural land is drained by means of underground pipes, that a Plan of the Drains be attached to the deeds of the property and also to any agreement for the letting of such land."

Mr. A. R. White seconded, and *Mr. Acland, Mr. R. W. Hall, Mr. John Evens* and *Mr. J. R. Spraggon* spoke on the motion, which was put to the meeting and carried.

Register of Movements of Live Stock.—*Mr. R. W. Hall* moved:—

"That the Council urges upon the Ministry of Agriculture the desirability of bringing into operation as soon as possible the Order foreshadowed in paragraph 2 of Report (No. 11) of the Proceedings of the Agricultural Advisory Committee for England and Wales made to the Council and presented at its last meeting on 27th October, 1925, proposing a Register of movements of live stock."

Mr. A. Matthews seconded the resolution, and *The Minister* said that he had no doubt that such a register would be very valuable in connection with the control of animal disease. The Ministry was at work upon a draft, but some difficulties in detail had arisen which it was expected would shortly be overcome. The resolution was put to the Meeting and carried.

Agricultural Advisory Committee's Report.—The adoption of the Report (No. 12) of the Proceedings of the Agricultural Advisory Committee of England and Wales was moved by *Sir Douglas Newton*, and agreed.

AGRICULTURAL ADVISORY COMMITTEE FOR ENGLAND AND WALES.

Report (No. 12) to the Councils of Agriculture for England and Wales on the Proceedings of the Agricultural Advisory Committee. The last report to the Council was presented on the 27th October. Only one Meeting of the Advisory Committee has taken place between that date and the date of the present Report, viz., on 4th November. At the opening of the Meeting, the Minister, The Rt. Hon. E. F. L. Wood, M.P., received the warm congratulations of the Committee on his appointment as Viceroy-Designate for India.

The death of Mr. John McCaig, a member of the Committee, sitting as a nominee of the Secretary for Scotland, was reported and was received with very great regret. A resolution of appreciation of his work and of condolence with his family was unanimously passed.

1. **Foot-and-Mouth Disease.**—The Committee was informed of the steps which were being taken to deal with the present outbreak of Foot-and-Mouth Disease. It agreed that the Ministry should take power to require a farmer to put his animals under cover when danger of infection threatened, provided that course were in his case practicable. Such power would be taken by the Ministry under a General Order which would be applied locally as circumstances required. It was also agreed that fat cattle might be moved from one infected area to another for slaughter, provided, in cases where such movement was desired, that the animals were inspected by a veterinary surgeon before entraining, and were slaughtered at a large abattoir where the offal could be turned into manure, the name of such abattoir to be specified in the Order.

2. **Minimising Risk of Importation of Disease.**—A Memorandum was circulated dealing with the steps suggested to minimise the risk of the importation of Foot-and-Mouth Disease. Orders to the following effect were suggested—

(1) Prohibiting meat cloths, wrappings, sackings, etc., used for or about meat (imported or otherwise) from being brought into contact with animals until they had been boiled or otherwise sterilised.

(2) Prohibiting boxes, crates, baskets, etc., used for or about meat or meat products (imported or otherwise), except cooked or preserved meats or meat essences, from being brought into contact with animals.

(3) Requiring hay and straw used at the time of importation for packing merchandise to be accompanied by a certificate by a

British Consular Officer of the country of origin as to its efficient disinfection.

(4) Prohibiting hay and straw used as packing for merchandise (whether home or foreign) from being brought into contact with animals or being used as manure.

(5) Prohibiting exposure at any market or sale of animals, of all trees or shrubs packed in hay or straw (whether imported or not).

The Committee discussed these proposals and concurred generally in them. Some doubt was expressed as to the practicability of the disinfection in (3) and as to the enforcement of (4).

[Since the Meeting, Orders giving effect to all proposals except (3) have been put into operation.]

Other Measures for Preventing Spread of Disease.—The question of the importation of straw for manufacturing purposes in connection with chairs, horse-collars, etc., and the question of the washing and disinfection of motor-cars on landing from the Continent were also raised, and the officers of the Ministry undertook to examine into both questions again.

3. **Compulsory Registration of Bulls.**—It was stated on behalf of the Ministry that a draft Bill for the Compulsory Registration of Bulls would shortly be prepared and would be submitted in due course to the Committee.

26th November, 1925.

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POTATO EELWORM.

J. STRACHAN, M.A., B.Sc. (Agr.), N.D.A.,
and T. H. TAYLOR, M.A.,
Department of Agriculture, Leeds University.

Economic Importance of Potato Eelworm.—Within the last ten years increasing attention has been paid to this disease, which affects potato crops in many parts of the country. From several places, notably Kirton, cases have been reported to the Ministry where badly attacked main crop potatoes have given full yields. On the other hand, however, potato eelworm can do very serious damage; a badly attacked crop can be almost a complete failure, and the crop lifted may weigh no more than the seed planted. The reason for this variation is obscure, and in this respect and others more investigation is needed before the conditions under which eelworm attack assumes its most serious aspect can be stated.

Symptoms of Attack.—Attacked plants are slow in coming through the ground; the tops are dwarfed and yellow prematurely; the tubers are usually small; during the summer and autumn little round bodies or "cysts," fairly visible to the naked eye, can be seen amongst or adhering to the roots. These little round "cysts" are the bodies of the female eelworms distended with eggs.

Description of the Eelworm.—The eelworm is similar to if not identical with that on the Continent known as "beet eelworm" (*Heterodera schachtii*), but since with us the attack is mostly on potatoes, it is often referred to as the "potato eelworm." It is a soil organism, and its attack is confined mostly to the roots of the potato, although the tubers, also, may sometimes be infected. The individual worms are too small to be studied by the naked eye, but under the microscope it is not difficult to make out something of their life history and mode of attack.

A healthy potato rootlet, when washed free from soil, is cylindrical in form, colourless, and except for the sap-carrying vessels almost transparent. On the other hand, a root invaded by eelworm soon loses this regularity of structure. It becomes bent and distorted, and shows greyish or brownish streaks or patches, marking the places where the eelworms have been burrowing. The worm itself is very transparent and difficult to see when inside the root, but if the root be dissected in a drop of water, it can be separated from the surrounding cells (cortex). Sometimes, when the root is broken across the worm projects from the broken end. Sometimes also, a worm can be found entering the root with its tail still outside.

After reaching a certain size, the eelworms cease to feed and their appearance changes. The slender eel-like form is lost and the body becomes thicker, assuming an outline which may be compared to that of an oxygen cylinder of which the neck would represent the head end of the worm. The skin becomes coated with a whitish substance, which renders the maturing worm visible under a pocket lens or even to the naked eye. In the males no further change takes place externally, but inside the thickened skin the body re-forms giving rise to a new eelworm, long and thin once more, coiled lengthwise, filling, except for the narrow neck, the old skin. When one of these male "pupæ," ripe and ready for emergence, is pricked with a needle point, the enclosed worm immediately uncurls and protrudes to the exterior.

The female worms, after assuming the club-like form, continue to thicken, becoming oval, then lemon-shaped and finally

spherical. During the changes, the overlying tissue of the root ruptures and the worms, suspended by their heads as by a stalk, project freely on the surface of the root. The white covering flakes off and exposes the smooth and somewhat polished surface of the skin, which, greyish at first, soon turns brown and finally brownish-black. At this stage, the eggs, which have become fully fertilised, develop, drawing their sustenance from the parental tissues, which, except for the skin, completely break down. The females thus become mere tough-walled bags (cysts) full of embryo-containing eggs. Those cysts can be found from late summer onwards, becoming, when the roots rot away, incorporated in the soil, where they remain until the following season, when their progeny of eelworm larvæ escape from their covering and begin the new attack.

Potato Eelworm in South Cave.—In South Cave, an important potato-growing district in the East Riding of Yorkshire, potato eelworm has been known for a considerable time under the name of potato " dab." Below is given the experience of one farmer there, together with observations made on his farm by the Department of Agriculture at Leeds University since the year 1923. The soil of the farm is a light sand.

Spread of the Disease.—The farmer in question first noticed potato " dab " on his farm about twenty-one years ago (about 1904), as a small patch in the centre of a field (A), where a potato clamp had been located the previous year. Subsequently, frequent crops of potatoes were taken, and by 1917 " dab " had crept over the entire field. By this time also, it had become very troublesome in a second field (B). Here the first patch of infection was seen in 1914, or ten years after the disease was first noticed on the farm. This was not the end, for in 1923, the scourge broke out in a third field (C), in this instance as several patches. Thus the slowly spreading pest has invaded three of the five arable fields of the farm in a period of twenty-one years.

Movements of the Eelworm.—The following observations apparently throw some light on the movements of the eelworm through the soil.

(*a*) Field B in 1923 was potatoes (Great Scot). In 1922 it had also been potatoes, except for the end rigs. In 1923, it was interesting to observe that the potatoes on those end rigs were much better than the general crop in the field, and of those four end rig rows, the outermost row was the best, the

next not so good, the third still worse, and the fourth, or innermost, worst of all.

(*b*) Part of Field C in 1923 was potatoes (Great Scot) and part rye. A small area that was badly crippled with eelworm in 1923 was planted again with potatoes (Arran Chief) in 1924. This area abutted on the land that had been rye the previous year, and one row from the rye stubble was also planted. The rye stubble row produced a moderate crop of potatoes, whilst on the next row and other rows the crop was practically a failure. An examination at the end of the year revealed that eelworm "cysts" were not nearly so numerous on the rye stubble row as on the other rows of the area.

(*c*) Field D is separated from Field C by a narrow earthen road, and although potatoes alongside this road in Field C in 1924 were extremely badly infected by eelworm and were practically a total failure, an excellent crop of potatoes was growing in September, 1925, on the other side of the road in Field D.

It would seem from those few observations that the eelworms do not spread extremely rapidly through the soil by their own movements. Implements of cultivation would no doubt help the spread by carrying the "cysts" along, and in support of this supposition, it was noted by the farmer that subsequent to 1914, in Field B, the disease spread from the first patch of infection along the rows rather than across them.

Rotation and its Effect on the Eelworm Attack.—In Field B in 1917 the potato crop was extremely poor owing to "dab." A rotation of crops was then taken, mangolds in 1918, barley in 1919, two years clover mixture in 1920 and 1921. The field thus rested four years rewarded the farmer in 1922 with a very good crop of potatoes. Another example of the result of resting an infected field for several years from potatoes was provided by Field A. Here the potato crop in 1917 suffered severely from eelworm. After six years' rest from potatoes, during which time other crops were grown, Majestic, Great Scot, Arran Chief and King Edward potatoes were planted in 1924. An excellent crop of tubers was lifted, weighing out on an average at 10½ tons per acre. It would thus appear that if land infected by this scourge is rested several years from potatoes, other crops being substituted, a satisfactory crop of potatoes can then be got. It should also be noted that Zimmerman, who has written on potato eelworm in Germany,* emphasises the importance of a rotation of crops in checking the disease.

* Zimmerman: Zeits. f. Pflanzenkrankheiten, 30, 1920, p. 139.

Two Crops of Potatoes in Succession on Land that has once shown Signs of Infection.—In Field B, where it will have been observed above that the potato crop was extremely poor in 1917 and very good, after a four years' rest, in 1922, potatoes (Great Scot) were again planted in 1923. They were practically a failure owing to potato eelworm. A similar result was got in Field C, where eelworm infection was noted in the potato crop (Great Scot) of 1923. In 1924 potatoes (Arran Chief) were again planted on part of the field, and the return was so bad that on a considerable part of the area the crop amounted to little more than an equivalent of the seed planted. Thus it would seem that potatoes should not be grown two years in succession on land that has once shown signs of the disease in the past. This can be understood when it is noted that since each " cyst " contains a large quantity of eggs, the eelworms that have fed on the previous crop can produce a vast progeny to destroy the next.

Potatoes Lifted as Green Crop and as Main Crop.—In Field B in 1922, part of the crop was lifted as " green top " and part as " main crop." In the following year it was noticed that the potatoes growing on the " green top " area of the previous year were distinctly better than those on the area where the main crop had been grown. It is thought possible that the lifting of the plants early as " green top " had destroyed some of the eelworms before they had passed into the " cyst " stage, but little reliance should be placed on such an isolated observation until it is fully confirmed by similar experience.

New Scotch Seed *v.* **Once-Grown.**—Field C in 1923 was planted with Great Scot potatoes, part of the field with new seed from Scotland and part once-grown on the farm. Both lots were apparently attacked in equal degree.

Sulphate of Potash Dressings.—In 1924 in Field C, three plots of potatoes (Arran Chief) were laid down on an area that had shown eelworm amongst the potatoes the previous year. All three plots received sulphate of ammonia at the rate of 2 cwt. per acre and superphosphate at the rate of 4 cwt. Plots 1 and 3 received sulphate of potash in addition, Plot 1 at the rate of 10 cwt. per acre and Plot 3 at the rate of 2 cwt. per acre. The result of the experiment was as follows:—

Plot.	Sulphate of Potash.	Yield.
1	10 cwt. per acre.	1 ton 18 cwt. per acre.
2	0 "	0 " 18 " "
3	2 "	3 " 0 " "

It was seen during the experiment that the whole area was not uniformly attacked by the eelworm, one corner of Plot 3

being less heavily infected, and this accounts for the yield of this plot being comparatively high. During the experiment it was interesting to see that Plot 2 (the no sulphate of potash plot) was sharply defined from Plots 1 and 3 by a very poor growth of top.

In 1925, soil from Plots 1, 2 and 3 was placed in large boxes and similar dressings applied as in the previous year. Two more boxes were added. One contained soil from Plot 2 (Box 4) and the other soil from the adjoining end rig of the field (Box 5). This end rig soil was identical in texture and appearance to the soil from the plots, but with the difference that it appeared to be free from eelworm. All boxes received sulphate of ammonia at the rate of 2 cwt. per acre and superphosphate at the rate of 4 cwt. per acre. The additional materials that were added are indicated below. Three potatoes (Sharpe's Express) were planted in each box. All the tubers grew. The results were :—

Box.	Soil from	Additional materials applied. Rate per acre.	Yield.
1	Plot 1 (1924).	10 cwt. sulphate of potash.	5 oz.
2	„ 3 „	2 „ „	5 „
3	„ 2 „	0 „ „	2 „
4	„ 2 „	10 cwt. sulphur } 10 cwt. quicklime }	2 „
5	End rig. (Soil practically free from eelworm.)	2 cwt. sulphate of potash.	14 „

In both years, the crop where sulphate of potash was applied was double that where it was not applied, but eelworm was abundant on all the plots dressed with sulphate of potash, and the returns from those plots were very poor indeed compared with the yields from similar land free from eelworm. The sulphate of potash cannot be regarded as having efficiently checked the potato eelworm.

Methods of Control.—The above experiences suggest the following :—

(1) A suitable rotation of crops.

(2) Potatoes should not be taken two years in succession on land that has once shown signs of potato eelworm.

(3) Care should be taken not to carry the soil from infected areas to non-infected areas through such agencies as implements, potato sets, etc.

(4) The potatoes should be cleared from the land as thoroughly as possible to prevent stray plants appearing in the intervening crops of the rotation, thus providing

food for the eelworms and helping to carry on the trouble.

(5) The potatoes from infected areas are usually small and, consequently, they are likely to be fed to pigs. It is not known whether the "cysts" will be killed in the dungheap, and hence it would be well to take the precaution of boiling pig potatoes in order to destroy any "cysts" in the adhering soil. Soil from potatoes from infected areas also should not be swept on the dungheap.

It would be a great advantage if some more direct means of controlling the potato eelworm could be discovered, the necessity of adopting a rotation in which potato crops do not occur frequently being a great handicap. Especially is this the case in a district like South Cave, amongst small holders, where a living has to be made from a small area.

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JANUARY ON THE FARM.

J. R. BOND, M.Sc., M.B.E., N.D.A. (Hons.),
Agricultural Organiser for Derbyshire.

Land and Crops.—Land work in January is generally in the nature of overtaking arrears and making preparations for the busy period which begins with the first spell of dry weather after the 15th of the month. Weather conditions determine what is possible: if the land is persistently wet, team work may be entirely suspended; if frozen hard, manure carting may be the chief occupation; if tolerably dry, which is very unusual on medium and heavy soils in January, wheat, winter oats, barley and beans may be drilled or broadcast and harrowed or ploughed in.

The decline in prices of barley and oats and the higher level of values in wheat will doubtless influence many farmers to try to get wheat sown on land that may be ready in January or February. If the summer should be hot and dry, wheat would be the more successful crop, and oats might suffer from frit-fly. In a cool wet summer oats might be a better crop than wheat sown after Christmas. If wheat is intended, the seed should be sown at the first reasonable opportunity; sufficient seed, 3 bushels per acre, should be used; and a complete dressing of artificials should be applied, such as 2 cwt. of superphosphate, ½ cwt. of muriate of potash and ½ cwt. of sulphate of ammonia per acre. In 1924 I observed an instance where Yeoman wheat sown on 5th February without top dressing failed completely,

but made a fair stand where the fertiliser was applied. Bearded Red is a very hardy sort, suitable for sowing between Christmas and the end of February; Victor, Standard Red or Squareheads Master and Little Joss are other hardy sorts; but Iron, Rivetts and other late ripening sorts should not be sown at this time of the year.

Where "seeds" have failed and the difficulty cannot properly be overcome by leaving the previous year's lea for another year, the failed "seeds" land may be cropped with beans for grain, with oats and peas for hay, or with mixed corn for silage or for grain. All these alternatives are most likely to succeed if sown early. For further details the reader is referred to Mr. J. C. Brown's article in the June issue of this *Journal*.

In January pastures are generally free of stock, and such as are entitled to a dressing of phosphates (with or without potash according to requirements) may conveniently be treated this month. Many good farmers make it a rule to dress one-fourth or one-fifth of their pasture area every year, and they agree that few investments will return such a high rate of interest as money laid out in pasture improvement. Fields that graze off unevenly, however, may require additional attention, fertiliser being broadcast by hand on the rough places only. Matted old grass land may be renovated by a slow process of liming, chain harrowing and heavy stocking with cattle receiving artificial foods; but a much quicker process is to be recommended where practicable. An excellent demonstration of the possibilities of such land may be seen near Alsop-en-le-Dale. The field was ploughed in January, 1925, slagged, and in May seeded with rape and a mixture containing wild white clover. In this case, lime had been applied a few years ago, but without obtaining the desired result; generally it is necessary to lime on the back of the furrow before seeding-down again.

A High Yielder.—Maud raises many problems, supports some theories, and contradicts others. She is a Lincoln Red cow weighing about 11½ cwt., and of dairy type, but neither the appearance of her udder nor any other feature would proclaim her to be a ten-galloner. During her last lactation period—28th August, 1924—10th August, 1925—she yielded 1,160 lb. of milk but never exceeded 57 lb. on a recording day. She brought her fourth calf on the 18th October—having been dry 69 days—and was then in fair but not fat condition. On

the first weekly recording day she gave 48½ lb. and the next four weekly weighings showed continuous increases as follows: 58¼, 71¼, 82 and 86¼ lb. From 20th November onwards her milk was recorded at each milking, thrice milking being adopted on the 28th. The yields were as under:—

Twice Milking, lb.

	5.30 p.m.	*5.30 a.m.*	*Daily Total.*
November 20-21	44	42½	86½
21-22	44½	40	84½
22-23	44	44¼	88¼
23-24	44½	43½	88
24-25	43½	43½	87
25-26	44¼	42½	86¾
26-27	40½	48½	89
27-28	42½	46½	89

Thrice Milking, lb.

	1.30 p.m.	*8.30 p.m.*	*5.30 a.m.*	*Daily Total.*
November 28-29	30	26¾	30¼	87
29-30	30¾	32½	32½	95¾
30- 1	33½	34	34¼	101¾
December 1- 2	33¼	34½	34¾	102½
2- 3	36	35½	35¾	107¼
3- 4	36½	35	35	106½
4- 5	35¾	36¼	35¾	107¾
5- 6	38¼	35½	35¾	109½
6- 7	36¼	35	35¾	107
7- 8	36½	35¼	35¼	107

Maud is milked by Clara, a land girl, who possesses the art of coaxing cows into giving her a few pounds more than other milkers can obtain. Indeed the farmer believes that Maud would yield him only 25 lb. at a "meal," if he himself took this important operation in hand. Clara also watered Maud from the pail until 4th December, when the water-bowl installation was completed. This was no small matter, as Maud required 5 pails after each milking, drinking a daily total of at least 30 gallons, or nearly 3 gallons of water per gallon of milk yielded.

Rationing.—Maud's ration has been gradually increased and modified according to what have been seen or thought to be her actual needs; and, although she has lost a little flesh, she is not poor. Since calving she has had her share of marrow-stem kale, which is distributed on the pastures at the rate of 90-100 lb. per cow per day; she has also eaten a little grass during her daily run-out from 8.0 a.m. to 1 p.m. Hay has been restricted to one foddering of about 6 lb., fed in the evening; and latterly the allowance of brewers' grains has been omitted, as it was found that she failed to eat them when the

ration of concentrates had been increased beyond about 24 lb. per day. Her daily consumption of cake and meal at the time of writing is 34 lb., fed in three equal portions. This consists of a mixture of equal parts by measure of palm kernel cake, linseed cake, dairy nuts and bran. Mineral matter other than salt is also added to the ration; but, although a salt brick has lain in its holder at the head of the stall for some months, Maud has not yet licked it. Maud's present ration supplies approximately the quantities of digestible protein and starch equivalent that we believe to be requisite for a yield of 10½ gallons, but her daily consumption of dry matter is nearly 50 lb.

It only remains to be said that, essential as are sufficient nutriment, frequent access to water and efficient milking, these will not ensure high yields in each and every cow. Some will decline in yield after the second or third week of lactation, in spite of every known precaution, and will convert additional nutriment into fat instead of milk. Others, however, continue to rise in yield in response to additional nutriment, etc., until they reach their maximum of 5, 6 or 7 or more gallons per day. These are the most profitable producers, and it is mainly by discovering and encouraging such cows during their first few weeks of lactation that high herd averages are obtained.

Weather Lore.—Being constantly out of doors and being engaged in an industry that is largely controlled by seasonal influences, farmers in all countries naturally take great interest in weather conditions. Before weather forecasting was placed on a more scientific basis, much attention was paid to the happenings on certain days, which were considered as ominous of the ensuing weather. Thus the twelve days preceding Christmas were in France believed to represent month by month the weather of the ensuing year. In this country there was a similar superstition with regard to the twelve days beginning with 31st December. Christmas Day, however, was regarded as portentious; if it fell on a Friday, the early part of the winter would be severe but the following spring and summer would be favourable. When Christmas came while the moon was new, and especially at new moon, farming would prosper during the ensuing year.

Possibly there is some truth in proverbial observations with regard to the effect of different kinds of weather at particular periods on the subsequent progress of crops. "If you see grass in January, lock your grain in the granary." Tusser

observed that " A kindly good Janiveer, freezeth the pot by the feer (fire)." The prejudice against wet weather in this month is indicated by the couplet " December's frost and January's flood never boded the husbandman's good." The somewhat unusual occurrence of thunder in November and December recalls the old belief that this presages abundance of corn.

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NOTES ON MANURES FOR JANUARY.

SIR JOHN RUSSELL, D.Sc., F.R.S.,
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Manuring of Seeds Leys.—Temporary leys are so important on the farm that every effort should be made to obtain the best possible results from them. Patchiness may be caused by lack of lime or lack of potash. Assuming the preparation and the seed were both good, the crop may be improved by three types of manuring: (1) lime may be given now, but better to the barley in which the seeds are sown; it would be even better applied for the root crop preceding the barley; (2) phosphates may be given, but this is better done for the roots; (3) potassic fertilisers, kainit, muriate, or 20 per cent. potash salts can be given now to clover leys that are more than two years after the last dressing of farmyard manure.

Uses for Nitrogenous Manures.—Since the war there have been great developments in the manufacture of nitrogenous fertilisers as a result of the conversion of war-time factories to peace-time uses. In consequence supplies of these fertilisers are improving so much that scarcity is no longer feared and, in spite of the great increase in consumption, prices tend to fall. Indeed, German experts are expecting so great a supply that they are exploring new ways of using sulphate of ammonia, and they have designed an ingenious method, now being tested at Shinfield, Reading, in which heavy dressings, up to 6 cwt. sulphate of ammonia, are applied to grazing land with the purpose of ensuring a rapid early growth and continuance of young herbage no matter how intensively the grass is grazed. The young character of the herbage is maintained by shutting off and mowing the grass whenever there is too much for the animals to eat; it is not allowed to grow more than six or eight inches in height before it is cut. The experiment will be watched with considerable interest.

Cyanamide again.—The cyanamide or nitrolim on the market prior to the war suffered from two defects; a tendency to become very dusty, when it was highly disagreeable to the workers, and a liability to contain or to produce a poisonous substance, known as dicyanodiamide, which might seriously injure the crop and, in any event, detracted from the fertilising value. During the war extensive factories were erected on the Continent for making cyanamide, it being wanted for high explosives, and efforts are naturally being made to keep them going now. Some 115,000 tons of pure nitrogen were "fixed" by this process in 1924, corresponding to about 750,000 tons of cyanamide. Much of this is converted into ammonia, but periodically it is offered direct to farmers. It is understood that the difficulty about dustiness has been overcome, but we should need to be satisfied that the other trouble in regard to dicyanodiamide has also been overcome before recommending it to farmers. No one should use it on a large scale without making a preliminary trial.

Chalk, Limestone or Lime.—Interest in the use of these substances has revived considerably and the Bath and West Society is arranging trials which promise good results. For farmers near the chalk the problem is whether purchased lime or carted chalk is the more economical. No general advice can be given and a trial is the best way of settling the question. 2½ tons of ground chalk put on now are probably as effective as one ton of ground burnt lime, but if the chalk is not ground it would be safer to use three or four times this amount and leave it on the surface to be shattered by frost before being worked in. As between limestone and burnt lime the difference is mainly, but not entirely, one of cost; where analysis has been made, comparison is easy, the basis being the percentage of pure lime (CaO) in each; where there is no analysis, a rough comparison can be made by reckoning 56 parts of pure lime as equivalent to 100 parts of the carbonate (pure limestone or pure dry chalk). In practice of course the substances never are pure, though some of the ground limestones offered to farmers are very good. We continue to hear of waste lime products in the north, which are offered at very attractive prices.

On some of the clays, especially in the eastern counties, arable crops respond better than grass to lime, and the different arable crops vary among themselves in their response. The dressing given should therefore be determined as much by the crop as by the soil. White and red clover, meadow foxtail and barley

are sensitive to sourness and require more lime than alsike, oats or potatoes, while rhubarb requires none at all. If a soil is so sour that the clovers and barley cannot grow well it may be dressed with sufficient lime to ensure success, or it may be given less lime or even left without any and used only for alsike, oats and potatoes. Tests have been devised to show how much lime is needed for these various crops, and a scheme of experiment drawn up by the Ministry's Committee on Liming is in process at various centres. Usually the county organiser could advise individual farmers and arrange for any test to be made.

Does Farmyard Manure Spoil by Exposure to Frost?—This question is often asked at farmers' lectures. So far as the evidence goes, farmyard manure loses ammonia after it has been spread on the ground and also, to a less extent, when it is left in small heaps in the field ready for spreading. Once the manure heap is opened there is no real safety for the manure till it is ploughed under. Frosty weather does not prevent the loss, indeed, if anything, it is less favourable than damp, showery weather.

Superphosphate for Potatoes.—At a recent conference on the manuring of potatoes at Rothamsted there were presented some remarkable results of experiments by Mr. Wallace at Kirton, in which 2 cwt. per acre superphosphate gave better results than larger quantities. Mr. Wallace was careful to remind his hearers that results obtained on one farm might not necessarily be obtained on another, but he has opened up a fruitful line of inquiry, and it is hoped that others will repeat his experiments under their own conditions. (These experiments are dealt with on p. 893.)

Mineral Phosphates and Slag.—Four years ago, Professor Gilchrist revived interest in the old experiments on mineral phosphates made by Dr. Aitken at Pumpherstone, and found that North African phosphate, ground so finely that 80 per cent. passed through the 120 sieve, satisfactorily increased the yields of grass and of arable crops at Cockle Park, and was in his view comparable with high-grade basic slag. In trials made by the Agricultural Education Association, the North African phosphate (which, however, was not very finely ground) proved inferior to low soluble slag on grass land but superior to it on arable land. It would be valuable to have further trials with material as finely ground as in the Cockle Park experiments.

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	*Average Price per ton during week ending Dec. 9th.*				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London.
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	13. 2	...	12.17	12.17	16. 7
„ „ Lime (N. 13 per cent.)	...	12.10	...	12.10	19. 3
Sulphate of Ammonia, neutral (N. 21.1 per cent.)	12.13*	12.13*	12.13*	12.13*	(N)12.0
Kainit (Pot. 20 per cent.)	3.10	3. 0	...	...	...
„ (Pot. 14 per cent.)	3. 0	2.15	2.15	2.15	3.11
Potash Salts (Pot. 30 per cent.)	4.15	..	...	4. 9	2.11
„ „ (Pot. 20 per cent.)	...	...	..	3. 2	3. 1
Muriate of Potash (Pot. 50-53½ per cent.) ...	9. 2	8. 2	8. 7	9. 2	3. 5
Sulphate of Potash (Pot. 48-51½ per cent.) ...	11. 0	11. 5	10.10	11. 0	4. 4
Basic Slag (T.P. 34 per cent.)	...	...	3. 4§	...	...
„ „ (T.P. 30 per cent.)	...	...	...	2.15§	1.10
„ „ (T.P. 28 per cent.)	...	2.11§	...	2.10§	1. 9
„ „ (T.P. 26 per cent.)	...	2. 3§	...	2. 5§	1. 9
„ „ (T.P. 24 per cent.) ...	2. 9§	1.19§	1.18§	..	...
Superphosphate (S.P. 35 per cent.)	...	...	3.14	3. 6	1.11
„ (S.P. 32 per cent.)	...	...	3.11	...	...
„ (S.P. 30 per cent.)	...	2.17	3. 7	3. 0	2. 0
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	8.15	8. 5	8. 7	8. 0	...
Steamed Bone Flour (N. ¾, T.P. 60-65 per cent.)	6. 2†	6.15†	6. 5	5.12	...
Fish Guano (N. 6¼, T.P. 10 per cent.) ...	...	...	...	9.15	...
Burnt Lump Lime	1. 8	1.12	1.18	2. 1	...
Ground Lime	1.15	2. 1	2. 8	1.15	...
Ground Limestone	1. 7	...	1. 4	1. 5	..

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

§ Prices include cost of carriage from works to town named. Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire and London prices are for not less than 4-ton lots delivered within a limited area. Cost to purchasers in other districts will be greater or less according to the distance of different purchasers from the works.

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MONTHLY NOTES ON FEEDING STUFFS.

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The Effect of Structure of the Digestive Tracts of Farm Animals on Feeding Methods.—Farm animals can be divided into two main classes, those which can deal easily with coarse fodders, and those which cannot. Of those which can deal with coarse fodders two sub-classes are recognised, those which chew the cud, such as sheep, cow and bullock, and those which do not, such as the horse. If we examine the digestive tracts of those animals which can deal with coarse fodders, we shall find that there is always special provision made for this purpose. Thus in the sheep, cow, and bullock, the stomach is compound, and consists of 4 separate chambers,

only the 4th or last compartment working as the true stomach. The *first*, the paunch, acts as a storehouse for the hastily swallowed food; the *second*, the honeycomb bag, is specially adapted for liquid material; and the *third*, or manifold, acts as a mill and grinds to a juicy state the food which has already been ground between the teeth. In these animals, the small intestine and the large intestine are comparatively simple. In the case of the horse, the stomach is a simple stomach, and is unfitted for dealing with coarse fodder. If, however, we examine the intestine, and particularly the large intestine, we find special provision made for the coarse fodder; and specially large compartments, the cæcum and colon, are adapted for dealing with the digestion of coarse fodders. On the other hand, in the case of the pig, the stomach is simple, and the intestines are simple, and the pig should not be expected to be able to deal very effectively with coarse fodder. In view of the discordance of views held with regard to the pig's capacity to deal with silage, this fact is interesting. If we take the relative capacities of the digestive tracts of farm animals we get some rather significant figures. Expressing these in gallons we get the following table :—

Animal.	Total capacity of digestive tract.	Capacity of stomach.	Capacity of small intestine.	Capacity of large intestine.
Pig ...	6	2	2	2
Sheep ...	7	4	2	1
Horse ...	44	4	12	28
Cow ...	71	50	14	7

From the figures we can deduce the following facts, facts that are supported by practice. First, the pig, although capable of dealing with a certain amount of coarse fodder, is limited in this respect, and the capacity of the digestive tract is such that when fattening it becomes necessary to see that the main bulk of the food consists of non-bulky, easily digested meals. The horse, although able to deal with a fair amount of coarse fodders, owing to the large capacity of the large intestine, has only a limited stomach capacity. It therefore becomes important to study the question of the bulk of the ration. Horses at rest can be fed largely with chaff, but where fast or hard work is expected, we must increase the amount of easily digested non-bulky foods, and at the same time cut down the chaff feed. The sheep, unlike the pig, has a very capacious stomach and can therefore deal easily with coarse fodders, which should always form a considerable proportion of the ration. The cow, and the bullock, owing to the capacity of

Description.	Price per Qr. s. d.	lb.	Price per Ton. £ s	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	§ Starch Equiv. per 100 lb.	Price per Unit Starch Equiv. s.	Price per lb. Starch Equiv. d.	§ Protein Equiv. %
Wheat, British	—	—	10 7	0 15	9 12	72	2/8	1·43	9·6
Barley, British Feeding	—	—	8 15	0 11	8 4	71	2/4	1·25	6·2
„ Canadian :—									
No. 4 Western	31/0	400	8 13	0 11	8 2	71	2/3	1·20	6·2
„ Feed	30/6	„	8 10†	0 11	7 19	71	2/3	1·20	6·2
„ American	30/3	„	8 10	0 11	7 19	71	2/3	1.20	6·2
„ Russian	29/9	„	8 7	0 11	7 16	71	2/2	1·16	6.2
Oats, English, White	—	—	9 10	0 13	8 17	60	2/11	1·56	7·6
„ „ Black and Grey	—	—	9 0	0 13	8 7	60	2/9	1·47	7·6
„ Scotch, White	—	—	10 0	0 13	9 7	60	3/1	1·65	7·6
„ Canadian :—									
No. 2 Western	31/9	320	11 2	0 13	10 9	60	3/6	1·87	7·6
No. 3 „	29/3	„	10 5	0 13	9 12	60	3/2	1·70	7·6
Feed „	26/9	„	9 7	0 13	8 14	60	2/11	1·56	7·6
„ American	26/9	„	9 7	0 13	8 14	60	2/11	1.56	7·6
„ Argentine	27/6	„	9 12	0 13	8 19	60	3/0	1 61	7·6
Maize, Argentine	40/6	480	9 8	0 12	8 16	81	2/2	1·16	6·8
„ South African	39/9	„	9 5†	0 12	8 13	81	2/2	1·16	6·8
Beans, English Winter	—	—	10 10†	1 10	9 0	66	2/9	1·47	20·0
„ Chinese	—	—	11 7*	1 10	9 17	66	3/0	1·61	20·0
Peas, English Maple	—	—	11 13	1 6	10 7	69	3/0	1·61	18·0
„ Japanese		—	33 10*	1 6	32 4	69	9/4	4·02	18.0
Dari, Egyptian	—	–	12 10	0 14	11 16	74	3/2	1·70	7·2
Millers' Offals :—									
Bran, British	—	—	8 2	1 5	6 17	42	3/3	1·74	10·0
„ Broad	—	—	8 17	1 5	7 12	42	3/7	1·92	10.0
Middlings—									
Fine Imported	—	—	9 0	1 0	8 0	69	2/4	1·25	12·0
Coarse, British	-	—	8 2	1 0	7 2	58	2/5	1·29	11·0
Pollards, Imported	-	—	6 17	1 5	5 12	60	1/10	0·98	11·0
Meal, Barley	—	—	10 0	0 11	9 9	71	2/8	1·48	6·2
„ Maize	.	—	10 0	0 12	9 8	81	2/4	1 25	6·8
„ „ South African	—	—	8 17	0 12	8 5	81	2/0	1·07	6·8
„ „ Germ	—	—	9 10	0 18	8 12	85	2/0	1·07	10·0
„ „ Gluten Feed	—	—	9 12	1 5	8 7	76	2/2	1·16	19·0
„ Locust Bean	-	—	9 12	0 9	9 3	71	2/7	1·38	3·6
„ Bean	—	—	12 5	1 10	10 15	66	3/3	1·74	20·0
„ Fish	—	—	20 0	3 19	16 1	53	6/1	3·26	48·0
Linseed	—	—	20 15	1 9	19 6	119	3/3	1·74	19·0
Linseed Cake, English 12% Oil	—	—	13 10	1 15	11 15	74	3/2	1·70	25·0
„ „ 10% Oil	—	—	12 17	1 15	11 2	74	3/0	1·61	25·0
„ „ 9% Oil	-	—	12 10	1 15	10 15	74	2/11	1·56	25·0
Soya Bean „ 6% Oil	—	—	12 0	2 10	9 10	69	2/9	1·47	36·0
Cottonseed Cake, English 5½% Oil	—	—	7 10	1 12	5 18	42	2/10	1·52	17·0
„ „ Egyptian 5½% Oil	—	—	7 2	1 12	5 10	42	2/7	1·38	17·0
Decorticated Cotton-seed Meal 7% Oil	—	—	10 17	2 10	8 7	74	2/3	1·20	35·0
Coconut Cake 6% Oil	—	—	9 12	1 9	8 3	79	2/1	1·12	16·0
Ground Nut Cake 7% Oil	—	—	9 17†	1 14	8 3	57	2/10	1·52	27.0
Decorticated Ground-Nut Cake 8% Oil	—	—	12 15†	2 11	10 4	73	2/10	1·52	41.0
Palm Kernel Cake 6% Oil	—	—	7 15	1 1	6 14	75	1/9	0·94	17·0
„ „ Meal 6% Oil	—	—	8 5‖	1 1	7 4	75	1/11	1·03	17·0
„ „ Meal 2% Oil	—	—	8 7†	1 2	7 5	71	2/1	1·12	17·0
Feeding Treacle	—	—	7 2	0 9	6 13	51	2/7	1·38	2·7
Brewers' Grains :—									
Dried Ale	—	—	8 7	1 2	7 5	49	3/0	1·61	13·0
„ Porter	—	—	7 17	1 2	6 15	49	2/9	1·47	13·0
Wet Ale	—	—	1 7	0 8	0 19	15	1/3	0·67	4·8
„ Porter	—	—	1 2	0 8	0 14	15	–/11	0.49	4·8
Malt Culms	—	—	7 5†	1 12	5 13	43	2/8	1·43	16·0

* At Liverpool. † At Bristol. ‖ At Hull.

§ The figures in these columns have been corrected in accordance with the tables given in the Report of the Committee on the Rationing of Dairy Cows.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of November and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 1s. per ton. The food value per ton is therefore £8 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 5d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·29d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices :—N, 11s. 10d.; P_2O_5, [illegible]; K_2O, 2s. 11d.

the digestive tract are best able to deal with coarse fodders, and these should always bulk largely in the ration. The only exception here is in the case of the very heavy yielding milch cow, where the amount of concentrated feeding stuffs required for milk production is such that considerable bulk is provided from the concentrated feeding stuffs alone. In this case, it will be necessary to feed the concentrated meals first, leaving the animal to ration itself afterwards with regard to the coarse fodders.

* * * * * *

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follows:—

	Starch Equivalent.	Protein Equivalent.	Per Ton. £	s.
Barley (Imported)	71	6.2	8	10
Maize	81	6.8	9	7
Decorticated Ground Nut Cake ...	73	41.0	12	15
„ Cotton Cake ...	71	34.0	12	15

Add 10s. per ton, in each case, for carriage. The cost per unit starch equivalent works out at 2.24 shillings, and per unit protein equivalent, 2.75 shillings.

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The " food values " which it is recommended in the Report of the Committee on Rationing Dairy Cows should be applied by Agricultural Organisers and other advisers in connection with advisory schemes on the rationing of dairy cows, are given in the November issue of the Ministry's *Journal.*)

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FARM VALUES.

CROPS.	Starch Equivalent.	Protein Equivalent.	Food Value per Ton, on Farm. £	s.
	Per cent.	Per cent.	£	s.
Wheat	72	9·6	9	7
Oats	60	7·6	7	15
Barley	71	6·2	8	10
Potatoes	18	0·6	2	2
Swedes	7	0·7	0	17
Mangolds	7	0·4	0	16
Beans	66	20	10	2
Good Meadow Hay	31	4·6	4	2
Good Oat Straw	17	0·9	2	0
Good Clover Hay	32	7·0	4	11
Vetch and Oat Silage	13	1·6	1	13
Barley Straw	19	0·7	2	4
Wheat Straw	11	0·1	1	5
Bean Straw	19	1·7	2	7

AGRICULTURAL RETURNS OF ENGLAND AND WALES, 1925.

PRODUCE OF CROPS.

THE following preliminary Statement, issued on 27th November last, shows the Estimated Total Produce and Yield per Acre of the Potato and Root Crops in England and Wales in 1925, with Comparisons for 1924, and the Average Yield per Acre of the Ten Years 1915-1924.

Crops.	Estimated Total Produce.		Acreage.		Estimated Yield per Acre.		Average of the Ten Years 1915-24.
	1925.	1924.	1925.	1924.	1925.	1924.	
	Tons.	*Tons.*	*Acres.*	*Acres.*	*Tons.*	*Tons.*	*Tons.*
Potatoes -	3,213,000	2,696,000	493,139	452,242	6 5	6·0	6·1
Turnips & Swedes -	9,191,000	11,538,000	805,486	830,895	11·4	13·9	12·5
Mangolds	7,108,000	7,823,000	357,976	388,048	19·9	20·2	19·0

Potatoes.—The detailed estimates of the yield per acre of potatoes show that the crop is heavier than was previously expected. The growing weather of August and September had a very beneficial effect on the crop, which at the end of July had promised to be light. The average yield per acre over the whole of England and Wales is estimated at 6½ tons, or two-fifths of a ton above average and half a ton more than in 1924. The acreage planted was considerably greater than last year, so that the estimated total production on agricultural holdings of 3,213,000 tons exceeds the small total of 1924 by 517,000 tons, and is 90,000 tons greater than the average of the ten years 1915-24. On the whole the tubers are sound, but there is some disease in several districts. Most of the crop was stored dry and clean in the first half of October, but much of that carted later was clamped in dirty condition. A few of the latest crops in the north had not been carted before the recent severe frosts. Yields are above average in most counties, relatively the poorest results being in the Lindsey Division of Lincoln and a few midland and south-eastern counties.

Turnips and Swedes.—Yields of turnips and swedes are very variable throughout the country and on the average are lighter than usual. Since August the weather has been generally favourable for growth, but large areas were sown late as a result of the drought of June and the first half of July. The average yield per acre is estimated at 11·4 tons or more than 1 ton below average, and 2½ tons less than last year. The crops are relatively the worst in Lincoln (Lindsey), Nottingham, Leicester, Rutland and the extreme northern counties. In Wales yields are about three-fourths of a ton per acre below average. The estimated total production of 9,191,000 tons is 2,347,000 tons less than in 1924, and, apart from 1921, smaller than in any year since 1885 when produce returns were first collected.

Mangolds.—The season was much more favourable for mangolds, and the estimated average yield per acre of these roots is 19·9 tons, or nearly 1 ton above the ten year's average, but still rather below last year's very good crop. Yields were well above average in the eastern

and west midland counties, but below average in the north-east midlands, and in the north. The estimated total production is 7,108,000 tons, or 715,000 tons less than last year, and about 400,000 tons below the ten years' average, the acreage being smaller than in any of the past ten years. The roots are reported to be of a very good quality.

Winter Keep.—Supplies of winter keep for live stock are generally considered about sufficient, but fodder is none too plentiful on many farms. The quantities of roots and straw available are often on the short side and on some hill farms hay crops were poor.

Sugar Beet.—Estimates have this year been obtained of the yields per acre of sugar beet, and these indicate that the crop will probably average between 8 and 9 tons per acre of washed and topped roots. Last year the quantity as weighed at the factories after washing averaged rather more than 8 tons per acre over the total acreage in the country, this being a higher yield than in any of the previous three years. The total production of sugar beet this year as a result of the much increased area will probably not be less than 450,000 tons against 180,000 tons in 1924.

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MISCELLANEOUS NOTES.

Clean Milk in Kent.

THE result of the past year's Clean Milk Competition in Kent was very briefly noted in a recent issue of this *Journal* (Oct., 1925, p. 616). In a more extended report which has now come to hand, a comparison of last year's competition with those held in 1923 and 1924 gives some interesting information. In regard to tests for bacterial count and *Bacillus coli* the results and comparative figures work out as follows :—

Year.	*Samples up to Grade A Standard.*	*Samples up to Certified Standard.*
1923	51 per cent.	26 per cent.
1924	87 " "	67 " "
1925	86 " "	68 " "

The tests of the surprise samples taken by the inspecting judges agree very closely with those above; in fact in all three competitions they have been slightly better. The most interesting development, however, is shown in the keeping properties of the milk, which is a matter of practical importance both to farmers and housewives. The farmer naturally dislikes receiving back from his dairyman churns of milk returned as " sour on arrival and unfit for sale," and the housewife is equally annoyed when milk in the larder " turns " in a few hours. For the purpose of the competition, each sample of milk was placed in an incubator kept at 60° F., representing the normal living-room temperature, and from time to time part of the sample was tasted and boiled. The " life " of a sample ceased as soon as any taint could be detected in the milk or it clotted on boil-

ing. The gradual improvement of the keeping qualities of the milks submitted during these three competitions is shown by the fact that the average time that samples kept "sweet" in the 1923 competition was 2 days 12½ hours; in the 1924 competition, 3 days 4 hours; and in last year's competition, 3 days 10½ hours. These figures alone are sufficient to justify the trouble and expense of running a clean milk competition. In the 1923 competition there were 16 samples of milk submitted that kept perfectly sweet and without a taint for 4 complete days. In the 1924 competition this number was increased to 41 samples and in 1925 to 93 samples, of which 5 samples were still sweet at the end of the fifth day and two at the end of the sixth day. The dairy farmers of this county are rapidly learning how to produce milk of good keeping qualities, and it is curious to note in this connection that one of the prize winners in the 1924 competition actually received a complaint from a customer, who had been ordered to drink sour milk by her doctor, and who, finding that the milk set aside for the purpose did not "turn" as quickly as she expected, suspected the addition of preservatives.

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Poultry Films.

THE films illustrating various aspects of modern British poultry culture referred to on page 681 of the November issue of the *Journal*, have now been released for public display. As already stated, the films show all stages of commercial egg and table-poultry production, and have been produced by the British Instructional Films, Ltd., in collaboration with the Ministry. The pictures are intended for purposes of educational propaganda among people interested in the commercial possibilities of poultry-keeping in this country, and, judging from reports already received, achieve their object very satisfactorily. Exhibitions of the films, which can be seen in a sitting of about two hours, should prove interesting and suggestive to audiences such as farmers' and poultry-keepers' societies, agricultural institutions, and gatherings in rural districts. Copies of the films can be purchased outright for £125, or may be hired at a charge of £5 per show, the film company paying carriage one way. All correspondence in regard to the purchase or hire of these films should be addressed to British Instructional Films, Ltd., Regent Studio, Park Road, Surbiton, Surrey.

Duck Laying Test at Wye College.

THE results have now been issued of the duck laying trial at the South-Eastern Agricultural College, Wye, Kent, which commenced on 1st November, 1924, and concluded on 2nd October last year, a period of 48 weeks. In all, 155 ducks were entered, each entry consisting of five birds, and the whole were run as one large flock on free range over grassland. Of the total number entered, three died during the test and two did not lay at all. For the purpose of recording, all birds were trap nested, and they were divided into four breed sections:—(1) Khaki Campbell (12 pens); (2) Indian Runner (9 pens); (3) Buff Orpington (4 pens); and (4) Magpie (6 pens). Eggs were graded according to weight, a first-grade egg weighing 2 oz. or over; eggs below 2 oz. being relegated to second grade and not counting for awards. The Khaki Campbell furnished the three highest individual duck records with scores of 277, 261 and 258 respectively; and also the highest pen records, with totals of 1,123 eggs (average per bird 224.6) and 1,090 eggs (average per bird 218) respectively. They also secured 8 out of the 11 Certificates of Merit awarded to pens with an average of 170 or more eggs per bird. The highest pen score in the Indian Runner Section was 913; in the Buff Orpington Section, 769; and in the Magpie Section, 830.

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Lantern Slides on Poultry Subjects.

IN the issue of this *Journal* for January, 1924, it was announced that the Ministry had arranged for the preparation of a set of lantern slides for the use of county poultry instructors and others engaged in lecturing on the various branches of poultry husbandry. The list of slides now available totals approximately 300, the most recent additions being to the series illustrating the development of the embryo chick, a further contribution by Mr. H. T. Atkinson, Instructor in Poultry-keeping to the Leicestershire County Council.

The subjects dealt with include housing, breeding, incubation, rearing, fattening, culling, table poultry and egg production, marketing, and external parasites and diseases of poultry.

Copies of any or all of these slides may be obtained direct from the makers, Messrs. Durbin's Drug Stores (Putney) Ltd., 131, High Street, Putney, London, S.W.15, at a flat rate not exceeding 10d. per slide, exclusive of carriage. Complete lists which contain explanatory notes will be supplied to poultry instructors on application to the Ministry.

The Spraying of Spurrey.

THE experiments in charlock spraying carried out in Devonshire in recent years, which were described by Mr. J. B. Passmore in the November issue of this *Journal* (p. 698), gave an opportunity for testing the effect of spraying on Spurrey in growing corn crops, particulars of which Mr. Passmore has been good enough to furnish. A number of plots were marked out and sprayed or broadcast at different rates per acre with various substances such as sulphate of ammonia, kainit, nitrate of soda, copper sulphate. These were applied when the Spurrey was flowering and was growing in a thick mat 3 in. or 4 in. high. The most successful results were obtained on plots sprayed with copper sulphate, using solutions of 20 lb., 22 lb., and 25 lb. per acre respectively in 50 gallons of water. In no case was the corn checked at all severely by the spraying.

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Register of Growers of Certified Stocks of Potatoes in 1925.

DURING the past season, Inspectors of the Ministry have examined many fields of growing crops of potatoes of varieties which have been approved as immune from wart disease, with a view to the certification of the crops under the Wart Disease of Potatoes Order of 1923, as being true to type and reasonably free from rogues. A list of the growers of these certified stocks has been prepared; and copies may be obtained, price 1s., from the Ministry, the names and addresses of growers of certified stocks of any particular variety, together with the numbers of the relative certificates will also be supplied on application. Growers are reminded that the only potatoes which may be planted on land infected with wart disease are those from crops which have been so certified.

The list also includes the names and addresses of growers of varieties not approved as immune from wart disease, whose crops were inspected while growing and found to be true to type. The importance of planting true stocks is becoming better realised by potato growers, and the extension of the system of inspection to non-immune varieties has, it is believed, proved to be of material assistance both to growers and purchasers of seed potatoes.

The Board of Agriculture for Scotland has issued a similar Register of Scottish growers of approved immune varieties, and copies can be obtained from the Secretary, Board of Agriculture for Scotland, York Buildings, Queen Street, Edinburgh, price 2s. net, post free.

THE Ministry has received the following note on a useful method of destroying this weed from Mr. P. Murray Thompson :—

Eradication of Rest-Harrow.

Having to eradicate rest-harrow in an old pasture in Cumberland, we did so with salt. The areas in which the pest grew varied from a yard across to four or five yards. These areas we covered with a liberal dressing of salt, and repeated it if any plants appeared to have been missed. Naturally all grass was killed for the season, but very little rest-harrow reappeared. Where it did it was immediately resalted. The bare patches were reseeded with good seeds in the season after salting, and quickly formed a good sward.

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THE Regulations made under the Seeds Act, 1920, require, in the case of a sale of seed peas, that the seller shall deliver to the purchaser a statement in writing containing certain specified particulars including (1) the name and address of the seller; (2) a statement that the seeds have been tested in accordance with the provisions of the Act; (3) the kind of seed; (4) the percentage of purity if below 97 per cent.; and (5) the percentage of germination; provided that if the percentage of germination is not less than the authorised minimum percentage of germination prescribed in the Schedule to the Regulations (viz., 70 per cent.) a statement to that effect, which shall include the authorised minimum percentage of germination, shall be sufficient.

Germination of Seed Peas.

As was the case in 1924, there are indications that the germination of the 1925 crop of seed peas is below normal and that consequently a considerable proportion of the peas marketed this season will be found to germinate slightly less than the minimum percentage prescribed in the Seeds Regulations. The sale of seed peas with a germination of less than 70 per cent. is not contrary to the Regulations, provided the actual percentage of germination is declared. To avoid failures in the crop, it is advisable that seeds testing less than 70 per cent. should be sown rather more thickly than usual.

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Rural Industries.

THE first number of a new quarterly journal has just been published under the title "Rural Industries." Its object is to supply the many people interested and concerned in country industries with an accurate account of what is being done to promote their development and revival. As a matter of fact, the first number of the journal does much more than that, and leads the reader into many pleasant paths in a very useful, though somewhat neglected, country. It will not now be gainsaid that rural industries are likely to be of real value in securing the economic prosperity of the countryside and that they are therefore important. As is well known, this view is accepted by the Government, and grants are made annually in support of the development of rural industries to such bodies as the Rural Industries Bureau and the National Federation of Women's Institutes.

The new journal supplies a definite need in furnishing a connecting link between the various activities in rural industries all over the country, and in stimulating greater effort and competition in rural craftsmanship. The articles in it cover such subjects as the Welsh Textile Industry, the Carpentry Class, the Decline of Horse Traffic, a Simple Guide to Costing, the British Industries Fair and the exhibition there of Rural Industries. Rabbit-keeping for fur, etc., and it gives details of the scheme to provide a register of skilled craftsmen whose work can be recommended to the public. It is issued by the Rural Industries Bureau, 258, Westminster Bridge Road, S.E.1, and is on sale, price 6d. a copy.

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Farm Workers' Minimum Wages. — A meeting of the Agricultural Wages Board was held on 8th December, at 7, Whitehall Place, S.W.1, the Chairman, Lord Kenyon, presiding.

The Board considered notifications from Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and proceeded to make the following Orders carrying out the Committees' decisions:—

Berkshire.—An Order fixing minimum and overtime rates of wages for male workers and minimum rates for female workers to come into operation on 2nd Jan. (when the current rates are due to expire). The minimum rate for male workers aged 21 years and over is increased from 29s. 2d. to 30s. (for a week of 50 hr. all the year round). In the case of male workers under 21 years the minimum rates remain unchanged. The overtime rates for male workers of 17 years of age and over are reduced by ½d. per hr. in each case, the rate for workers aged 21 years and over becoming 8d. per hr. No change is made in the rates for female workers, the minimum rate in the case of workers aged 19 years and over being 5d. per hr.

Cornwall.—An Order fixing minimum and overtime rates of wages for male workers and minimum rates for female workers to come into operation on the 16th Dec. (when the current rates are due to expire) and to continue up to 15th Dec., 1926. The Order continues the present rates unchanged, the minimum rate in the case of male workers aged 21 years and over being 31s. per wk. of 51 hr., and in that of female workers aged 20 years and over 5d. per hr. The overtime rates for male workers aged 21 years and over are 9d. per hr. on week-days and 10d. per hr. on Sundays.

Derbyshire.—(a) An Order fixing minimum and overtime rates of wages for male and female workers to come into operation on 16th Dec. (when the current rates are due to expire) and to continue up to the 25th Dec., 1926. The Order continues the present minimum rates unchanged, the rate in the case of male workers aged 21 years and over being 8d. per hr., for a wk. of 54 hr., with an overtime rate of 10d. per hr. for Sunday employment. In the case of female workers the general minimum rate for workers aged 18 years and over is 5d. per hr. on week-days, with an overtime rate of 8d. per hr. for Sunday employment.

(b) An Order fixing special rates for male workers of 18 years of age and over for overtime employment on the hay and corn harvests in 1926, the rate in the case of workers aged 21 years and over being 9d. per hr.

Nottinghamshire.—An Order to come into operation on 14th Dec. increasing the minimum rate for male workers between 15 and 16 years of age from 13s. to 13s. 6d. per wk. of 50 hr.

East Riding of Yorkshire.—An Order to come into operation on 14th Dec. fixing a minimum rate of wages for male workers who are boarded and lodged by their employers but who do not fall within the categories mentioned in the existing Order (viz., foremen, beastmen, shepherds, third and fourth lads, horse lads and other beginners), the rate being 27s. for a wk. of 48 hr. in winter and 52½ hr. in summer, and not more than an additional 12 hr. on week-days and 3 on Sundays in attendance on animals.

Copies of the Orders in full can be obtained on application to the Secretary of the Agricultural Wages Board.

The next meeting of the Board will be held on Tuesday, 12th Jan., 1926.

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Foot-and-Mouth Disease.—Since the December *Journal* was issued, there have been five new centres of disease, namely, in Lincs. (Lindsey), on 23rd November; at Cardiff, on 26th November; in Staffordshire, on 2nd December; in West Sussex, on 3rd December; and at Brockenhurst, Southampton, on 15th December.

The number of outbreaks confirmed since 1st January, 1925, to 21st December inclusive is now 249, of which 224 have been confirmed since 25th September.

These latter outbreaks have involved 21 countries, and the slaughter of 7,195 cattle, 7,639 sheep, 31 goats, and 2,352 swine.

Whilst it has been considered desirable to maintain the Midlands and South of England (Regulation of Movement of Animals) Order of 1925 in force, it has been possible very considerably to reduce the limits of the infected areas, which now comprise 5 areas of 15 miles radius or greater, and 7 smaller areas.

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Minerals in Fish Meal—In the article on "The Value of the Minerals in Fish Meal for Fattening Pigs," which appeared in the November issue of this *Journal*, an error has arisen in the reproduction of Fig. 1 on p. 712. Pen No. 1 is there represented by the continuous black line, and pen No. 3 by the dotted line. The continuous line actually represents the live weight gain of pen No. 3, which was receiving the basal + fish meal ration, and the dotted line represents pen No. 1 on the basal ration without any supplement. The broken line representing No. 2 is correctly reproduced.

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Agricultural Show at Madrid.—The Department of Overseas Trade is informed that the General Association of Stock Breeders in Spain is organising an exhibition of cattle, poultry and apiculture, as well as agricultural machinery and implements, to be held at Madrid from 14th to 23rd May, 1926. It is suggested that British firms manufacturing agricultural machinery and dairy plant might take advantage of this opportunity to bring their productions to the notice of Spanish agriculturists. Full particulars may be obtained from the "Associacion General de Ganaderos," Calle de Huertas, num. 30, Madrid.

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QUESTIONS IN PARLIAMENT.

Dogs (Sheep Worrying).—In reply to a question asked by Mr. Foot Mitchell in the House of Commons on 3rd December, Sir H. Barnston said the attention of the Ministry of Agriculture had been called from time to time to cases of sheep worrying by dogs, but there was no information to show that such cases were on the increase. With regard to legislation to increase the penalties for not keeping dogs under control, the Dogs Acts of 1871 and 1906 already provide considerable penalties, and render the owner of a dog liable in damages for any injury done to cattle or sheep. The Minister did not, therefore, consider there was any need to introduce legislation to increase penalties for the contravening of these Acts.

Sheep Dipping. — In reply to a question asked by Mr. Foot Mitchell in the House of Commons on 26th November, Sir H Barnston said that according to information received by the Ministry of Agriculture the total number of sheep which had died during the last 12 months as a result of dipping is 628. Of this number 594 were dipped in arsenical dips; 13 were dipped in an arsenical dip for the first dipping, but in a non-poisonous dip for the second dipping. In 21 cases the Ministry had no information as to the dip used. In several cases the Ministry had received claims for compensation, but the applicants have been informed that the Ministry takes no responsi-

bility for any losses occasioned through dipping of sheep in a poisonous dip, and every approved dip is labelled with a statement to this effect. There is a large number of non-poisonous dips available for selection, and the choice rests with the owner of the sheep.

Animal Diseases (Research).—In reply to a question asked by Mr. Foot Mitchell in the House of Commons on 26th November, Sir H. Barnston said that research into animal diseases in England and Wales is carried on at a number of research institutes and colleges maintained or aided by grants from the Ministry of Agriculture. These include the Institute of Animal Pathology at Cambridge, The Royal Veterinary College, The London School of Hygiene and Tropical Medicine, and the Ministry's Veterinary Laboratory. Advisers in veterinary science are maintained at the University Colleges at Bangor and Cardiff, and at Armstrong College, Newcastle. A special committee had been set up to conduct research into foot-and-mouth disease, and work is being carried on under the direction of this committee at a number of laboratories. The total estimated expenditure on the maintenance of this work in the present financial year is £47,000. In addition, grants in aid of capital expenditure totalling £118,650 have recently been sanctioned by the Ministry in respect of the work. Reports on the research organisation set up by the Ministry and on the work of the various bodies concerned would be found in the Report on the Work of the Intelligence Department of the Ministry for 1921-24, and the First Progress Report of the Foot-and-Mouth Disease Research Committee. These reports are published by and obtainable from His Majesty's Stationery Office.

Produce (Marking).—In reply to a question to the President of the Board of Trade, asked in the House of Commons by Mr. S. Mitchell on 1st December, Sir H. Barnston said he had been asked to reply on behalf of the Minister of Agriculture. Complaints reached the Ministry from time to time of imported agricultural produce being sold as British, and the Minister was always ready to consider the desirability of instituting proceedings under the Merchandise Marks Acts, 1887 and 1894, which already enabled him to deal with cases where false descriptions are applied. He should add that, as announced by the Prime Minister on the 30th November in reply to Mr. A. M. Williams, the Government hoped to introduce next year a comprehensive measure which will, among other things, deal with the marking of imported agricultural produce.

Sugar Beet Industry.—In reply to a question asked in the House of Commons by Col. Day on the 16th November, Sir H. Barnston stated that on the 4th June last, 56,200 acres were returned as under sugar beet cultivation in Great Britain. In reply to questions by Col. Day on 7th December, and Mr. Harmsworth on 8th December, the Minister of Agriculture, Mr. Walter Guinness, said that the following beet-sugar factories are, or would be, in operation in the present manufacturing season:—Cantley (Norfolk), Kelham (Nottinghamshire), Colwick (Nottinghamshire), Spalding (Lincolnshire), Kidderminster (Worcestershire), Ely (Cambridgeshire), Ipswich (Suffolk), Bury St. Edmunds (Suffolk), Wissington (Norfolk), Greenock (Renfrewshire). Of these factories, Cantley and Kelham were producing sugar prior to the 1924-25 season, which was the first year of

subsidy. The amount of money expended as gross subsidy in respect of the 1924-25 manufacturing season was £509,200 4s. 6d., and up to 4th December, for the present manufacturing season, £378,965 14s. 5d. The total nominal capital of the above 10 factories was £2,845,000; the issued share capital being £2,151,264, of which amount, he was informed, £1,054,100 was owned by people of other than British nationality. The subsidy was not an investment in the factory companies; it was payable on sugar and molasses produced, and as such was a part of the revenue of the factories. Moreover, a considerable proportion of the subsidy was passed on to the farmers in the price which the companies are paying for beet, while farmers are gaining experience with this new crop.

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ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

Emerson, P.—Soil Characteristics; a Field and Laboratory Guide. (222 pp.) New York and London: McGraw-Hill Publishing Co., 1925, 12s. 6d. net. [63.11.]

Illinois Agricultural Experimental Station.—Bulletin 258:—Experiments with Subsoiling, Deep Tillage, and Subsoil Dynamiting. (18 pp.) Urbana, 1925. [63.196.]

University College of Wales, Agricultural Economics Department.—Labour Organisation on Four Welsh Farms, by *J. Morgan Jones.* (24 pp.) Aberystwyth, 1925, 6d. [338.1(429).]

British Power Alcohol Association.—Power Alcohol from Beet: A National Question. (16 pp.) London, 1925. [663.5.]

Bailey, C. H.—The Chemistry of Wheat Flour. [American Chemical Society Monograph.] (324 pp.) New York: Chemical Catalog Co., 1925, $4.00. [63.311; 664.6.]

Field Crops.

Arizona Agricultural Experiment Station.—Bulletin 104:—Green Manures and Soil Building Crops. (25 pp.) Tucson, 1925. [63.32; 63.165.]

Fruit.

Morton, J. W.—Practical Fruit Growing. (192 pp. and 4 pl.) London: Ernest Benn, 1925, 10s. 6d. [63.41.]

U.S. Department of Agriculture.—Farmers' Bulletin 1457:—Packing Apples in Boxes. (22 pp.) Washington, 1925. [63.41-198.]

Michigan Agricultural Experimental Station.—Special Bulletin 146:—Air-Cooled Storage for Apples. (54 pp.) East Lansing, 1925. [63.41-198.]

Plant Pests and Diseases.

Bourcast, E.—Insecticides, Fungicides and Weed Killers. A Practical Manual on the Diseases of Plants and their Remedies, for the Use of Manufacturing Chemists, Agriculturists, Arboriculturists and Horticulturists. Second Edition translated by *T. R. Burton.* (440 pp.) London: Scott, Greenwood & Son, 1925, 15s. [63.2; 63.295; 63.259.]

Blake, E. G.—Enemies of Timber: Dry Rot and the Death-Watch Beetle. (206 + xvii pp.) London: Chapman & Hall, 1925, 12s. 6d. [63.24-49; 63.27-49.]

Department of Scientific and Industrial Research.—Food Investigation Board Special Report No. 23:—Functional Diseases of Apples in Cold Storage, by *Franklin Kidd* and *Cyril West.* (15 pp. + xiii pl.) London: H.M. Stationery Office, 1925, 1s. [63.21-41.]

Oregon Agricultural Experiment Station.—Bulletin 216:—The Control of Core Breakdown in Pears. (16 pp.) Corvallis, 1925. [63.21-41.]

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NOTES FOR THE MONTH.

Report of the Proceedings under the Agricultural Wages (Regulation) Act, 1924.

THE first annual report,* required to be made by the Minister of Agriculture and Fisheries to Parliament, of proceedings under the Agricultural Wages (Regulation) Act, 1924, will be issued shortly. For the purpose of the preparation of the report, each Agricultural Wages Committee and the Agricultural Wages Board as required by the Act has submitted a report of its proceedings to the Minister, and these have been utilised in the compilation of the present report.

The steps taken in fixing, varying, or cancelling minimum rates of wages are briefly outlined; and an analysis is made of the rates so fixed. A summary is also given of the action taken by the Agricultural Wages Committees in defining the employment which is to be treated as overtime employment; in determining the benefits or advantages which may be reckoned as payment of wages in lieu of payment in cash; in granting permits of exemption, and of the steps taken by the Ministry to secure the observance of the minimum rates. Comparison is also made between the current minimum rates of wages and the wages obtaining in 1914; the rates fixed by the previous Agricultural Wages Board, and those prevailing during the period of the Conciliation Committees, which shows that the minimum wages at present in force, taking the average of the country as a whole, are estimated to be about 74 per cent. above the pre-war level as compared with 160 per cent. during the "peak" period from August, 1920, to August, 1921, and 56 per cent. during the years 1923 and 1924.

The appendices to the report include the first annual report of the Agricultural Wages Board, and tables summarising the minimum and overtime rates fixed by the Agricultural Wages Committees during the year. The report gives a complete view of the working of the Agricultural Wages Act.

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* Copies will be obtainable through any bookseller or direct from H.M. Stationery Office, Adastral House, Kingsway, W.C.2.

(65259) P.6./R.4. 8,000. 2/26 M. & S.

The Commission on Ouse Drainage.

THE Commission appointed in April last by the Minister of Agriculture and Fisheries in connection with the Ouse Drainage District, have just issued their report.

As announced in the issue of this *Journal* for May, 1925, the Commissioners were directed to advise the Ministry on the following points:—

(i) The nature and extent of the essential works required to put the Ouse Drainage System in a proper state and the estimated cost thereof.

(ii) The degree of benefit likely to be conferred on the various areas and sub-areas, into which the Ouse Drainage District is at present divided, by the execution of such works as are reported by the Commissioners to be so required.

(iii) The ability of the several areas and sub-areas respectively to contribute to the cost of executing such works.

(iv) The amount of Government financial assistance which would be essential to secure the execution of such works.

(v) The amendments of the Ouse Drainage Order necessary or expedient for enabling the Ouse Drainage District to be drained effectually.

The Commission take a serious view of the present state of the Ouse Drainage District, and have come to the conclusion that besides work on the main tributaries of the Ouse, extensive works costing some 2½ million pounds are necessary for the improvement of the tidal river. Moreover, they are of opinion that the improvements recommended are essential if the contingency of submersion and inundation of the tract of fen land drained by the river Ouse—land of considerable value from the standpoint of food production—is to be removed.

Works recommended on the tidal portion of the river include the dredging and training of the outfall channel between the north end of the Marsh Cut (below King's Lynn) and Hull Sand Beacon (in the Wash)—a distance of approximately five miles; dredging the main river from the mouth up to Denver Sluice; making a new straight cut so as to abolish the Magdalen Bend, in order to shorten the course and improve the discharge capacity of the river; and improving the Hundred Foot River below the point of discharge from the Ouse Washlands. Works are also recommended for the better utilisation of the washlands, for the improvement of bridges and for the dredging of channels and repairing of banks in the Fen area of the Old South Level draining through Denver Sluice.

In the light of the existing burdens on the lands which will be affected by these works, the Commissioners consider that a Government grant of at least 1¼ million pounds will have to be forthcoming if the works recommended for the tidal portion of the river are to be undertaken, and recommend that the cost of such works, so far as they are not met by an Exchequer

grant or otherwise, should be defrayed by a flat rate levied throughout the whole of the Ouse Draining District.

The Commission propose that while the works, which are calculated to take ten years to complete, are being carried out, the affairs of the Ouse District shall be in the hands of a small Board, consisting almost entirely of nominated members under a paid chairman. It is recommended that for this period the Drainage Board should consist of two members nominated by the Treasury, two nominees of the Ministry of Agriculture and Fisheries and four representatives of the ratepayers of the Ouse District, in addition to the independent chairman. After the execution of the works, however, the constitution of the Board should be varied, the County Councils being given strong representation and the elected membership being increased.

It is also proposed that a subsidiary Board should be set up to deal with the rivers in the South Level, but the Commissioners feel that the Ouse Drainage Board should be given some general powers of control throughout their area, including the power of vetoing the execution of works which may affect the tidal channels until the works recommended are completed.

As far as the conduct of the affairs of the Ouse Drainage District is concerned the Commissioners have found it impossible to make any effective recommendations short of amending the existing law relating to drainage, chiefly in so far as it restricts the liability to rating to those who benefit directly from such works. Consequently they make some far-reaching recommendations on the subject of the incidence of rating for drainage works. They are of opinion that the principle upon which drainage rates are now assessed solely in accordance with assumed benefit should be modified, and propose that a contribution towards the cost of drainage works should be made by all the counties within a watershed, even though the actual drainage district or district to be drained may form only a small part of that watershed. Applying this doctrine to the Ouse District, the Commissioners recommend that the boundary of the actual drainage district (*i.e.*, the area where works are necessary and rates are leviable therefor) shall be revised on the basis of a contour line 20 feet above Ordnance Datum. This would mean that the upper portions of the Ouse and its tributaries would be taken out of the drainage district.

As regards the county contributions, these would be of two kinds, (1) contributions in respect of land outside the drainage district, but within the watershed, and (2) contributions in respect of land within the drainage district. The former would

have no relation to benefit, but are regarded by the Commissioners as a payment made in recognition of the fact that the discharge of water from outside the area of benefit results in additional expenditure being thrown upon that area, particularly in view of the fact that owing to modern improvements, the rainfall is voided more rapidly than in the past into the lower reaches of the river. The latter is viewed by the Commissioners somewhat in the light of an insurance against loss of rateable value to the counties which would, but for the works of improvement, be liable to the risk of widespread inundation.

Apart from their main recommendations, the Commissioners make many subsidiary recommendations, including one important new departure, namely, the collection of drainage rates—assessed on the basis of annual value—through the agency of the local rating authorities, while they feel that there are many other amendments of the Drainage Law which are required in order to facilitate the administrative procedure of Statutory Drainage Authorities.

Copies of the report (price 2s. each) can be purchased through any bookseller, or direct from His Majesty's Stationery Office, Adastral House, Kingsway, London, W.C.2. (Cmd. 2572).

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Danish Farming.

COMPARISONS between the farming methods of different countries are always difficult, and are almost bound to lack precision because of differences in the basic principles underlying practice. References to Denmark have been made almost time without number during the last forty years, because her agriculture has been regarded as so phenomenally successful. It may perhaps be said, however, that this country has not yet fully apprehended —in the sense of putting it into practice—the lesson that Denmark can teach.

At a meeting of the Royal Statistical Society on 19th January, Mr. R. J. Thompson, C.B., read a paper in which he made some fresh comparisons between the productivity of British and Danish farming in an entirely novel way, and raised some very interesting and fundamental questions as to the reason for the marked difference which is believed to exist between the two countries. The conclusion arrived at by the statistical comparison is that the average output per 100 acres of agricultural land is over 50 per cent. higher in Denmark than in Great Britain, after deducting the feeding-stuffs, seeds, and fertilizers which contribute to this production. The explanation of this

high figure is stated to lie mainly in the fact that as compared with Great Britain, Denmark carries a heavier head of stock in combination with a high arable area, and by growing crops on this arable area feeds this stock to a greater extent from her own soil. This is combined with a higher yield per acre in the case of certain crops, with a larger yield of milk per cow and with a larger output of eggs and poultry.

Taking those facts as a broad general conclusion, Mr. Thompson proceeded to examine the comparative costs of production, including wages and persons employed, the object being to determine whether there is any obvious explanation of the higher productivity of Denmark. While there does not appear to be any very serious or material difference in these respects between Denmark and Great Britain, it may well be that costs of production in Denmark are really and effectively lower than in Great Britain owing to the co-operative purchase of feeding-stuffs, etc., to greater personal labour on the part of the farmer, and also to the fact that though cash wages seem to be much the same in both countries Danish labour may be cheaper owing to longer hours and greater efficiency.

The real crux of the problem, however, lies not in the gross or net output, or even in the costs of production, but in the net return or profit to the producer. Whether the British farmer is, or is not, securing from the soil as great a quantity of produce as is obtained by farmers in other countries he is presumably producing as much as it pays him to produce at current-prices. This leads to the question, if a large gross production and a large arable acreage tend to the agricultural prosperity of Denmark, why is not the same system applicable to this country? To this there is no simple answer.

Apart from the question whether costs of production are really and effectively lower, Mr. Thompson thought that it is quite possible (1) that the Danish farmer produces on the average a higher grade of article, and thus obtains a higher price; (2) that by improved methods of marketing and organisation he obtains a larger share of this price, thus securing a larger average return on his total production; and (3) that on the average he may be content with a smaller cash profit, or, alternatively, may be willing to work harder or more energetically to secure a similar return.

In this connection the size of the farms may have an important bearing. In Denmark, some 56 per cent. of the cultivated area is in farms of between 37 and 128 acres. In England and Wales, some 53 per cent. of the area is in farms of 150 acres and up-

wards. There is also the factor of ownership to be taken into account. The British farmer on the whole regards his farm as a money-making machine in which he invests such capital, labour, and enterprise as he expects will give him a satisfactory cash return. The Danish farmer, on the other hand, is more attached to his holding, and more inclined to look to the average result and to the long-period increase in the capital value of his farm. The mere fact that he is the owner encourages him to put more capital, more labour, and more enterprise into his undertaking over an average of years than the British farmer.

The conclusion to which Mr. Thompson finally comes is that it is the smaller size of the holdings, combined with the psychological effect of ownership, to which the main difference in the agricultural systems of the two countries is due.

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Agricultural Statistics, 1925.

THE Ministry's annual report on the acreage of crops, number of live stock, and number of agricultural workers employed, in 1925 has now been published. The report discusses the chief changes in the statistics generally as compared with 1924, and contains a review of the increase in the area of sugar beet in the last few years, and of the distribution throughout England and Wales of the area under this crop in 1925.

The tables attached to the report contain detailed figures of all crops and live stock for each county of England and Wales.

The report, which forms Part I of the Agricultural Statistics of England and Wales, 1925, may be obtained through any bookseller, or direct from H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2, price 1s. net or 1s. 1d. post free.

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Sugar Beet.

A FURTHER Research Monograph was issued by the Ministry early in January, entitled "Sugar Beet: the results of an Inquiry into the Costs of Production, Yields and Returns in 1924."* This monograph deals with a special investigation carried out by the Agricultural Economics Research Institute of the University of Oxford into the costs of production, yields and returns of sugar beet on certain farms in 1924.

The growing of sugar beet is a comparatively new venture in this country, and farmers have many questions to ask as to the economics of the crop. The monograph now published supplies

* Research Monograph No. 3. Obtainable from the Ministry, price 3s., post free.

a great deal of information which will serve to answer at least some of those questions, and it will also suggest to growers points which require their attention if the crop is to be a success in their hands. Possibilities of future economies and improved returns are discussed, and there is a careful examination of the factors involved in the problem of securing that the industry shall rest on a sound economic basis in the future.

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Tithe Act, 1925.

IN order to remove any misunderstanding, the Minister of Agriculture and Fisheries desires to state that the main provisions of the Tithe Act, 1925, which received the Royal Assent on 22nd December last, including the stabilisation of the annual value of tithe rentcharge at £105 per cent. and the transfer of ecclesiastical tithe rentcharge to Queen Anne's Bounty, do not come into force until the "appointed day"—a date not earlier than 6th April, 1926—to be fixed by Order in Council. It is anticipated that the "appointed day" will for these purposes be 31st March, 1927, but ample notice will be given of the final decision on this point.

The Act, therefore, makes no immediate alteration in the legal ownership of tithe rentcharge or in the basis of computation of the sums payable in respect of annual tithe rentcharge. For the present, the sum of £109 3s. 11d. continues to be payable for every £100 tithe rentcharge (par or commuted value) and half-yearly instalments of tithe rentcharge which became payable on the 1st January, 1926, are calculated on that basis.

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Movement of Animals (Records) Order, 1925.

THE Ministry has recently issued an Order under the above title which has for its object the provision of a ready means of tracing animals which may have been in contact with diseased or suspected animals in the country. Such tracing is of great importance in connection with foot-and-mouth disease. The Order is the outcome of one of the recommendations of the Departmental Committee on Foot-and-Mouth Disease, which reported on 2nd February, 1925, as follows:—

> "We are confident that the majority of the agricultural community would willingly assent to the keeping of a general record of movements, and we recommend that this should be made compulsory."

The Order accordingly requires a record to be kept by any person who moves or permits to be moved, any animal to or from any premises, except that the movement of animals between different parts of the same premises is not required to be recorded; neither are movements of animals from or to any premises for feeding, watering, or milking, provided the animal is moved back to the premises within 24 hours. This general provision will affect not only a farmer who keeps stock, but a dealer who moves animals to or from any premises, including markets, fairs, auction sales (whether or not the animals so moved have been purchased or sold), or from one market, auction, etc., to another, These records must be available for inspection at all reasonable times.

As far as pigs are concerned, pig dealers who already keep the register required by Article 4 of the Swine Fever Order of 1911, are not required to enter movements of pigs in the form of record prescribed by the new Order, but a note must be entered in the latter to the effect that a separate register is kept for pigs.

The records are not required to be kept by :—

(*a*) Any person moving, or permitting movement of, an animal to or from any lair authorised by a local authority for the temporary detention of imported animals awaiting exposure at a market, or awaiting movement for slaughter, or to or from any imported animals landing place or imported animals wharf. (Records of such movements are already provided for in the Orders of the Ministry governing the movements of imported animals);

(*b*) Any person whilst acting as a market authority or auctioneer at any market, saleyard, fairground or other premises, or any person responsible for holding an exhibition of animals; or

(*c*) A railway company moving or permitting the movement of any animals to or from a railway station for purposes of transit.

Farmers, dealers, or other persons required by the Order to keep a form of record may for this purpose use their own books provided that all the particulars specified in the form contained in the Schedule of the Order are included. It will, however, probably be found more convenient for each farmer to obtain special forms of record which will be placed on sale by printing firms accustomed to this work.

The Order came into operation on 1st February, 1926.

International Seed Testing Association.

AT the Fourth International Seed Testing Congress held at Cambridge in 1924, it was decided to enlarge the scope of the European Seed Testing Association formed at the Copenhagen Congress, to extend its activities to all countries of the world in which seed testing is practised, and to reconstitute it under the name of the International Seed Testing Association.

The object of this Association is that of "advancing all questions connected with the testing and judgment of seeds," which is to be attained by comparative tests and research at the various seed testing establishments throughout the world, by standardising the methods and terms used in connection with seed testing, and by the organisation of congresses, publication of technical papers, etc. Membership of the Association is limited to official stations controlled by Governments and Associations of official seed analysts.

The report of the work of this Association covering the period July, 1924, to September, 1925, has recently been issued by the President, Mr. Dorph Petersen, of Copenhagen. This report shows that 24 countries, representing all the principal seed testing associations of the world, have joined the Association.

The Association has set up a number of Committees, each of which is charged with the study of a special problem. These Committees include those which will deal with the following subjects:—

Provenance determinations;
Hard seeds and broken seedlings;
Moisture content and drying;
Investigations of genuineness of variety and of plant diseases;
Dodder;
Publications and registration;
Beet;
Research for countries with temperate climate;
Research for countries with warm climate; and
Sampling.

Special attention has also been given to the preparation of International Rules for seed analysts. Draft Rules were considered by the Executive Committee at a recent meeting, but having regard to the wide difference of opinion at present existing between the several stations as to what should be considered "pure seed," it was decided to postpone further action in this connection until closer agreement was reached upon this

important point. In May last, samples of 14 different species of seed were distributed by the Association to 57 different stations all over the world for the purpose of comparative testing. The results of these tests are now being tabulated and a report prepared by the President of the Association. A special series of garden seed samples has also been sent out to a number of selected stations for comparative testing. Arrangements have been made with the International Institute of Agriculture at Rome to publish monographs on seed testing and allied subjects written by members of the Association. These will be printed in five languages and copies sent to all members of the Association. The Institute has also agreed to print summaries of any important articles on seed testing, etc., which may appear elsewhere. Reports on "Provenance," "Seed Investigations," and the "Identification of Seeds of Italian and Perennial Ryegrass" have already been submitted to the Institute for publication. The preparation of a bibliographical list of new and old seed testing literature and the collection of a library of works on seed testing has been begun.

Arrangements are being made for the holding of the fifth International Congress in Rome in the early part of May, 1927.

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Enforcement of Minimum Rates of Wages.

DURING the month ending 14th January, legal proceedings were instituted against three employers for failure to pay the minimum and overtime rates of wages fixed by the Orders of the Agricultural Wages Board for workers employed in agriculture.

In one case heard at Easingwold the employer had paid a worker at less than the minimum and overtime rates laid down in the permit of exemption, which the local Agricultural Wages Committee, after seeing the worker, had granted. The worker had received £1 per week as compared with £1 8s. which he should have been paid according to his permit, and the total arrears ordered to be paid amounted to £19 4s.

In another case heard at Alcester (Warwick), the defendant was fined £2 and ordered to pay £7 12s. 6d. arrears of wages in respect of two workers.

In the third case heard at Pwllheli (Carnarvon) the defendant was ordered to pay £2 12s. 6d. fine and costs, and arrears of wages amounting to £5 10s. to the worker concerned.

The Agricultural Index Number.

THE general index number of the prices of agricultural produce in December was the same as in November, being 53 per cent. above the corresponding month in 1911-13, which compares with 63 per cent. a year ago and 56 per cent. in December, 1923. The reduction of 10 points in the index number as compared with December, 1924, is mainly due to the lower prices ruling for potatoes and fat sheep.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.	1925.
January ...	200	183	75	68	61	70
February ...	195	167	79	63	61	67
March ...	189	150	77	59	57	65
April ...	202	149	70	54	53	58
May ...	180	119	71	54	56	57
June ...	175	112	68	51	58	55
July ...	186	112	72	53	52	51
August ...	193	131	67	54	59	56
September	202	116	57	56	60	57
October ...	194	86	59	51	63	53
November	193	79	62	53	64	53
December	184	76	59	56	63	53

Wheat advanced in price during December and averaged 12s. 3d. per cwt. as against 11s. 2d. in the previous month, the index figure rising 18 points to 67 per cent. above the pre-war level. Oats were also dearer, an increase of 2d. per cwt. being recorded, but barley was 10d. per cwt. cheaper, the index figure of the former rising 2 points while that of the latter declined 6 points. Wheat sold at the same price as in December, 1924, while barley and oats realised less money, the reduction in the case of barley amounting to as much as 3s. 10d. per cwt., but oats were only 4d. per cwt. cheaper.

Fat cattle advanced in price, as is usual in December, but, as the increase was relatively less than in the base years, the index number dropped 4 points to 44 per cent. above 1911-13 and was the same as a year earlier. The advance in the price of fat pigs was continued, baconers being 6d. and porkers 8d. per 14-lb. stone dearer than in November. Fat pigs were about 85 per cent. dearer than in pre-war years, and were relatively

the dearest of all agricultural commodities, whereas in December, 1924, they were amongst the cheapest at 49 per cent. higher than in 1911-13. Fat sheep declined ½d. per lb. on the month, whilst in the base years there was an increase in December, and the index number fell 16 points to 47 per cent. above pre-war cost as compared with 84 per cent. above a year earlier. This is the first time for nearly four years that the index number for fat sheep has been lower than the general index number for all agricultural produce, and for a long period sheep were relatively very dear as compared with most other classes of agricultural produce. The restrictions on the movement of store stock, owing to foot-and-mouth disease, have closed most store stock markets, and average prices of dairy cows and store stock for the month of December are consequently not available.

Milk prices were unchanged in December and remained at 74 per cent. above pre-war. Butter was slightly dearer, but as the increase was relatively less than usual at this period of the year a drop of 3 points occurred in the index figure, while cheese was practically unchanged on the month. Eggs were 3d. per dozen cheaper, the index number falling on the month from 80 to 74 per cent. above the basic years. Both eggs and cheese were about 15 per cent. dearer than in December, 1924, but butter was slightly cheaper. Poultry averaged 60 per cent. above December, 1911-13, prices, all descriptions being cheaper than a year earlier when prices averaged 64 per cent. above pre-war.

Potatoes were about 4s. per ton dearer than in November, and the index number advanced 4 points to 64 per cent. above the base years. As compared with the corresponding month in 1923 and 1924 potatoes were relatively very cheap, average prices being lower by about 15 and 40 per cent. respectively, but even so the index figure is appreciably above the average of all agricultural commodities. Hay was somewhat dearer on the month but was still comparatively cheap at only 4 per cent. above pre-war cost.

The index number of apples was 9 points lower at 26 per cent. above 1911-13 although most descriptions were slightly dearer than in November, the increases being relatively much smaller than in the base years. All vegetables, except cabbage, advanced in price on the month, the general average being 75 per cent. above 1911-13. Cabbage and onions at 45 and 41 per cent. respectively above pre-war were comparatively cheap, while carrots, cauliflowers and Brussels sprouts at 111, 95 and 79 per cent. above were relatively dear.

The De Vecchis Beet-Sugar Process.

THE Ministry has accepted from Sir Charles Cottier an offer to transfer free of charge to the Ministry, the British and Irish rights in the De Vecchis Process for the production of sugar from beet. These rights have now been formally assigned to the Ministry free of charge but on certain conditions, particularly with regard to further experimental work.

The process was investigated last winter on behalf of the Ministry by a Technical Committee who visited Italy and saw the process in operation. Their report was presented to Parliament last February (Cmd. 2348 of 1925) and was published by the Stationery Office. The following extracts indicate the view taken by the Committee:—

> "The process has scarcely yet emerged from the experimental stage, but the principles are sound and the improvements in the plant necessary to render it commercially successful ought to present little difficulty. Once these difficulties were overcome the process would present very great possibilities for the development of the sugar-beet industry in this country. The conditions in England may differ in certain details from those in Italy, and the costs of production claimed for the De Vecchis process would need to be verified in actual operation here before any encouragement were given to its adoption by the sugar-beet interests in this country."

> "From the foregoing it will be understood that while the principles of the De Vecchis system are in our opinion technically sound, the whole question of their practical application is still open. Until definite figures concerning the cost of the De Vecchis system, working on a satisfactory industrial basis, can be produced, it is extremely difficult to say whether claims made for the system would be realised in practice. However, we consider that the system is sufficiently promising to justify further experimental work on the lines suggested. A definite decision as to the desirability of introducing the process into this country should await the results of the experiments which we advise."

In accordance with the undertaking given on the transfer of the British and Irish rights, the Ministry has arranged for experimental work for the improvement of the process to be conducted at the Oxford Institute for Research in Agricultural Engineering. This work is now in progress, and it is hoped that an interim report will be published within the next few months.

A non-exclusive licence to use the De Vecchis patents in this country has been granted to Sir Charles Cottier, and the Ministry is prepared to consider applications for licences from other persons.

SOME ASPECTS OF THE PROBLEM OF IMPROVING MILK YIELDS.

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EVERY year the Ministry of Agriculture publishes details of milk recording societies showing the average yield per cow in each society, and between these average yields there are considerable variations; nor is this haphazard, for societies giving high averages in one year are usually found high in the list in another. The farmer is naturally led to inquire why this is so, and to the more profitable question of how he can improve his own average. Such improvement can be made along one or, preferably, two lines—the raising of the standard of cow (by breeding and selection) and by improving the management (including feeding).

Improved Management of the Cow.—Taking the latter first, a fairly close association may be seen between the average yield of a society and the proportion of arable land in the area covered by its activities—that is to say, on the average, grass land districts show a lower average yield than those that are principally arable; for instance, from the figures we should expect an area containing $\frac{1}{2}$ an acre of arable land to 1 of grass to give an average of something like 6,383 lb., whereas one with 3 acres of arable to 1 of grass would be expected to average 6,905 lb.—an increase of between 8 and 9 per cent.

How does this arise? One of the chief reasons lies in the fact that in grass land districts dairy farmers have not the same variety of home-grown foods available, and it becomes a matter of necessity that a large proportion of their cows should calve in spring, to make the most of the growing season. In arable districts with a large and sometimes varied supply of roots, etc., for winter feeding, the farmer can calve a large proportion in autumn. There is, however, some difficulty in arranging for cows to calve regularly every autumn, owing to the fact that it is easy to miss a cow's "heat" period in winter. This happens, not only because the heat periods are shorter in winter than in summer (sometimes only 6 to 10 hours) and so are overlooked if the period falls in the night, but also because the signs of heat are not so marked, especially when cows are kept tied up.

It is the difficulty in getting cows to calve regularly during the late autumn months which not only causes a large loss

in milk yield, but also upsets the regular supply which is so necessary when contracts are made, or consumers are served direct, leading either to loss of trade or to the buying of down-calvers in a bad buying market.

Some evidence of this difficulty is afforded by the Ministry's Market Prices returns, which show that the price of down-calvers is usually noticeably higher from October to December than for the rest of the year. This is probably due to a demand for the replacement of those cows whose service could not be accomplished at the required time during the preceding winter. In this respect, again, the arable farmer is at an advantage, records showing that in his case there is not so much delay in service during winter, presumably because the more suitable feeds he can supply lessen the seasonal variation in heat periods.

Of one thing there is no doubt, namely, that the autumn calver has a better chance of making a big record than the spring calver. The latter gives a large flow to begin with, but falls off very rapidly. During May and the first week or so of June (varying, of course, with the weather) grass is an admirable food for all cows except the very high producer, but by midsummer it is getting fibrous and indigestible, and the cow cannot, because of its bulk, eat enough of it to support a large milk yield. Some farmers (this again is usually possible only in arable districts) grow catch crops for feeding green during the late summer and early autumn, and an investigation into milk records shows that this is to be very highly recommended. It is believed, however, that these are not usually fed early enough and that it is better to begin feeding them by the middle of June, before the milk flow begins to decline, than to wait until there is a shortage at the end of July or August.

The spring calver also suffers as a rule from an abnormal decline in yield during September and October at the onset of winter; these two periods (June-July and September-October) reduce her yield considerably. The autumn calver, on the other hand, maintains her yield well all through the winter, gets a considerable gain from the spring flush in the following year, and only begins to diminish in yield noticeably at the next bad period in June and July. With more care in feeding, and the supply of catch crops in summer, it is possible that this seasonal variation might be overcome, but at present, under ordinary conditions, the autumn calver would be

expected to give some 10 per cent. more milk than the spring calver.

The writers have analysed the records of two typical milk recording societies—Penrith (a grass land district) and Norfolk (predominantly arable)—and the fact emerged that the yield in the arable area was about 25 per cent. higher than in the other, despite the fact that the cows concerned did not appear to be any better as milk producers. The increase was due to more autumn calvings and to more even milking throughout the year; the Penrith records varied very closely with the condition of the grass in summer, and were very low comparatively towards the end of winter, possibly because of the lack of a supply of home-grown food at this time.

One method of improvement, then, lies in more autumn calvings (as far as milk contracts, etc., will allow) and careful rationing (on which advice is now available) not only during winter, but particularly from June to October, the period when the greatest mistakes are usually made.

Another point, which is largely under control, is the length of time that a cow is dry before calving; farmers usually acknowledge that it is best for her to be dry for 6 weeks or so; but too often she is not allowed more than a week or fortnight, and occasionally only a day or two. Of all the lactations in the Norfolk records, one-half were after dry periods of less than the recognised 6 weeks. A study of this question decidedly supports the view that a rest is advantageous; cows that were dry for less than 10 days before calving gave, on the average, 14 per cent. less milk in the next lactation than those having a 6 weeks' rest, whilst those dry for 3 months gave about 8 per cent. more. Heifers are usually more difficult to dry off than older cows, and the effect was found to be much greater with second calvers; in their case a heifer dry for only a week would be expected to give 25 per cent. less milk in the next (2nd) lactation than one dry for 6 weeks, whereas if dry for 3 months her yield would be 10 or 12 per cent. more than normal. The reason for this seems to be that a heifer will, if allowed a fair rest between her first and second lactation, not only get in good condition again (as would older cows, of course), but also would employ the time in making growth, both of the body and the udder, for the udder of a cow starts to grow in preparation for the next lactation after about the fifth month of pregnancy.

It cannot be too strongly insisted therefore that all cows, and particularly young ones, should have a rest of at least 6 weeks or 2 months before calving; after all, in the last month of a lactation a cow will probably only yield 30 or 40 gallons at most, whereas if she were dry then her yield in the next lactation would probably be increased by something like 100 gallons.

It is not known whether it is possible to escape the effects of a short rest by feeding the cow highly during the last weeks of the preceding lactation and when she is dry, but it is probable that the harm done would be alleviated by this procedure; yet it is likely that one of the uses of a dry period is that it allows the actual secretory part of the mammary gland to grow in preparation for the next lactation, and it seems probable that, however high the feeding, some considerable advantage will still be gained by drying the cow off some time before she is due to calve. It is hoped that before long the scientist will be able to supply definite information on this point.

Improving the Herd.—The second line that can be followed is that of improving the herd by rigorously and accurately culling the "passengers," and by breeding superior animals; the basis for this is provided by milk records. This is not, however, quite so simple as it sounds because a cow's lactation yield is influenced by many external factors. In judging the cows of one herd the influence of the system of management and feeding may reasonably be neglected, for it appears to affect good, bad, and indifferent cows in the same proportion. The lactation yield, however, will be influenced by the month of calving and dry period, as has been noted above, and also by age and service periods. By finding out how far these circumstances may affect a cow's yield, we can allow for them and so compare the yields of cows, made under different circumstances, with more certainty.

It is well known that a heifer will not usually give so much milk in her first lactation as she will when older; it has been found that the yield keeps on rising during the first six lactations and then declines. The single factor that may have the greatest influence on the lactation yield is the incidence of the next pregnancy; commonly this is roughly taken into consideration by statements such as that a cow gives 1,000 gallons in 300 days. This, however, is unsatisfactory because it takes no account of when the next calf is due—obviously the above record would be much more creditable if the cow was far

advanced in pregnancy at the end of the 300 days, than if she had only just been served. Further, this method does not take into account the fact that a cow's milk begins to fall off after the fifth month of pregnancy, the time at which the growth of the udder begins in preparation for the next lactation.

The most reasonable method of allowing for this is by means of what has been termed the service period—the interval between calving and the next fertile service; thus, if a cow calves on 1st June and is served again on 1st August her service period for that lactation is the interval between 1st June and 1st August, or 61 days; the statement that this cow gave (say) 1,000 gallons with a service period of 61 days has then a definite meaning, and it is possible to obtain corrections by means of which allowance may be made for different lengths of service period.

Correction Tables.—On p. 988 is a table of corrections for each of the four measurable factors influencing a lactation yield—month of calving, service period, age, and dry period—the application of which gives a standardised figure that can be used to compare one cow with another.

The standard for month of calving is the average of all months (conforming closely to March and September calvers) and consequently a percentage must be subtracted from the yield of all cows calving in the good calving months October to April, and a percentage added to the others.

For the service period the standard is 85 days, because a cow served 85 days after calving will be due again on the same date next year, as pregnancy lasts 280 days and 85 + 280 = 365. All those served sooner than 85 days after calving must have something added on to their yield, and those left empty for a long time must have something taken off. It will be seen that separate figures are given for first calvers; this is necessary because heifers usually milk longer than older cows, and give a level curve. Thirty per cent. must be added to the yield of a heifer to estimate her yield when mature (the 6th lactation); for age the standard has been taken as maturity, and the table gives the percentage to be added on to the other lactation yields in order to estimate the yield in the 6th lactation.

Finally, corrections are given for the length of the dry period before the lactation, and we have already seen that different figures must be used for second calvers, because they are still growing; here the standard is 40 days.

When we have applied the corrections to a cow's lactation yield, we arrive at an estimate of what that cow will give in her 6th lactation under standard conditions, these being:—calving in a "mean" month (*e.g.* March); being served so as to calve again on the same day next year; and having been dry for 40 days before the lactation. This estimate may then be used to compare that cow's milking capabilities with those of another whose yield has been standardised in the same way.

Let us take one concrete example; suppose a farmer has decided to dispose of one of two cows, and the difficulty of deciding which is the worst milker arises. He would have, probably, the records of several lactations of each, but we will only take one to economise space. Suppose *A* gave 6,000 lb. in her 2nd lactation, in which she calved on 10th May, was served again on 7th June (service period = 28 days) and had been previously dried off on 15th April (dry period = 25 days); suppose *B* gave 9,000 lb. with her 5th calf, calving on 10th October, being served on 20th February (service period = 133 days) and having been dry for 33 days before 10th October.

The corrections are:—

	A.	*B.*
Month of Calving	+ 3.4 per cent.	— 4.7 per cent.
Service Period	+ 21.3 " "	— 9.7 " "
Age	+ 18.0 " "	+ 0.7 " "
Dry Period	+ 8.0 " "	+ 1.5 " "
Total Correction	+ 50.7 " "	— 12.2 " "
Corrected yields	$6{,}000 + \frac{50.7}{100} \times 6{,}000$	$9{,}000 - \frac{12.2}{100} \times 9{,}000$
or	9,042 lb.	7,902 lb.

from which it appears that *A's* is a better performance.

Farming cannot be reduced entirely to figures, and it is not recommended that anyone should slavishly follow the dictates of these standardised yields; they should be used with a large admixture of commonsense and with full allowance for any circumstances that may have occurred to hamper the cow. Thus, if each of one individual's successive lactations be corrected, the figures arrived at will not agree absolutely, but under normal circumstances will be fairly close, and by taking the average of 2 or (better) 3 corrected lactation yields, quite a reliable figure is arrived at to represent the true milking capabilities of the cow. It is hardly necessary to point out to practical men the value of such a figure in culling, breeding, buying, and especially in judging the milk pedigree of a bull which is to be used in the herd.

TABLE OF CORRECTIONS.

Month of Calving.		*Service* (Standard: 85 Days).			*Age* (Standard: 6th Lactation).		*Dry Period* (Standard: 40 Days).		
Month of Calving.		Length of Service Period.	1st Calvers.	Others.	Lactation.		Length of Dry Period.	2nd Calvers.	Others.
	per cent.		per cent.	per cent.		per cent.		per cent.	per cent.
January	—0.9	0- 19 Days	+28.2	+33.9	1st	+30.6	0- 9 Days	+25.1	+14.0
February	—2.8	20- 39 ,,	+18.4	+21.3	2nd	+18.0	10- 19 ,,	+15.2	+ 8.8
March	—0.2	40- 59 ,,	+10.6	+11.9	3rd	+ 9.3	20- 29 ,,	+ 8.0	+ 4.7
April	—2.2	60- 79 ,,	+ 4.2	+ 4.6	4th	+ 3.7	30- 39 ,,	+ 2.8	+ 1.5
May	+3.4	80- 99 ,,	— 1.1	— 1.1	5th	+ 0.7	40- 49 ,,	— 1.3	— 1.2
June	+7.0	100-119 ,,	— 5.5	— 5.9	6th	—	50- 59 ,,	— 4.4	— 3.3
July	+5.0	120-139 ,,	— 9.2	— 9.7	7th	+ 1.4	60- 69 ,,	— 6.4	— 5.0
August	+3.0	140-159 ,,	—12.4	—12.9	8th	+ 4.8	70- 79 ,,	— 8.8	— 6.5
September	+0.5	160-179 ,,	—15.2	—15.5	9th	+10.4	80- 89 ,,	—10.4	— 7.6
October ...	—4.7	180-199 ,,	—17.6	—17.8	10th	+18.5	90- 99 ,,	—11.7	— 8.6
November	—2.6	200-219 ,,	—19.7	—19.7	11th	+29.4	100-109 ,,	—12.7	— 9.4
December	—3.8	220-239 ,,	—21.5	—21.4	12th	+13.7	110-119 ,,	—13.5	—10.1
		240-259 ,,	—23.1	—22.8			120 and over	—15.0	—12.0
		260-279 ,,	—24.5	—24.1					
		280-299 ,,	—25.8	—25.1					
		300-319 ,,	—27.0	—26.1					
		320-339 ,,	—28.0	—26.9					
		340-359 ,,	—28.9	—27.6					
		360-379 ,,	—29.8	—28.3					
		380-399 ,,	—30.5	—28.8					
		400-419 ,,	—31.2	—29.3					
		420-439 ,,	—31.8	—29.8					
		440-459 ,,	—32.4	—30.2					
		460-479 ,,	—32.9	—30.5					
		480-499 ,,	—33.3	—30.8					

FIELD EXPERIMENTS: HOW THEY ARE MADE AND WHAT THEY ARE.

SIR JOHN RUSSELL, D.Sc., F.R.S.,
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ALL farmers are interested in the results of field experiments, while those who are directly or indirectly concerned with the activities of the County Agricultural Education Committees, the management of Farm Institutes or the work of the County Organisers are also interested in the methods of carrying them out.

Looking back on the mass of experiments made by the county authorities, the farm institutes and the organisers since agricultural education began in its present form in 1894, one is struck by the enormous amount of labour that has been put into them. Many of the reports bear unmistakable evidence of painstaking observations and accurate weighings; many, however, do not give as much information as might have been hoped, considering the cost. The object of this article is to show how experiments can be arranged to give the maximum return for the work and money spent on them.

Essentials.—The first essential is to frame a perfectly clear idea of what is expected from the experiment. An experiment is simply a question put to nature in the hope of discovering some secret. Even in the best-planned experiments, the answer can usually be only " yes " or " no," while, if the experiment is badly planned, no answer can be given, and much of the labour and expense are wasted. An agricultural investigation is like the old game of clumps in which a person who has left the room returns to discover, if he can, something that has been agreed upon in his absence by those who remained behind. He may ask any question and will obtain the answer " yes " or " no "; if his questions are well enough framed, and if he can interpret the answers, he can always expect to guess the secret. But if the questions are badly framed, neither yes or no can be given as the answer, and in consequence no information is forthcoming.

A committee or an investigator considering a scheme of experiments should first look critically at the plan of the experiments, considering it as a series of questions, and ask whether each experiment or question is framed in such a way that a definite answer can be given. The chief requirement is simplicity: only one question should be asked at a time. For

example, if one wishes to know whether basic slag and kainit would be a better dressing for grassland than superphosphate and muriate of potash, it would not be sufficient to put down two plots, one treated with slag and kainit and the other with superphosphate and muriate. It is true that a difference in weight of herbage might be obtained, but the knowledge would be of no practical use because a different result might easily be obtained on the next field, or on the same field in the next year. The information cannot be interpreted because the question is not simple. It is really made up of two: is superphosphate better than basic slag? Is kainit better than muriate? The plan of the experiment must therefore include these tests.

It is obvious that no experiment can be properly planned without some knowledge of the subject. The experiment is to be an excursion into the unknown, but it must start from a basis of ascertained fact. Any child can ask a question that cannot be answered, but it requires a skilful and intelligent person with knowledge of his subject to ask a question that admits of a clear and unambiguous answer. The preliminary knowledge has usually to be obtained in some other way; often in the laboratory by scientific investigation, and this indeed is one of the reasons why an experimental station, such as Rothamsted, must be furnished with well-equipped laboratories. The purpose of the work is to obtain the knowledge with which the field experimenter must start before he can frame a clear question or devise a field experiment that will give a definite answer.

Interpretation of Results.—Having drawn up the simple question and carried out the work carefully, there arises the problem of interpreting the results. Interpretation is usually more difficult than devising the experiment, and much more difficult than making it. There may be no dispute about the facts, but considerable dispute about their meaning. Scientific controversies are often numerous and long-continued about the interpretation to be put upon recognised facts. In field experiments there is the difficulty that the result may not be due to the treatment, but to something entirely different. A famous fifth century writer on agriculture, Palladius, gives as a preventive against hail that the farmer should walk round the outside of the field carrying a tortoise upside down and laying it on the ground at each of the corners of the field. It is quite possible that the first man who did this escaped damage; the

error lies in connecting [illegible] Two [illegible] lie outside the plan of fiel[illegible] quite independent of the experi[illegible] and soil variations.

Three Desiderata.—In planning field experiments or studying the results to see what information they will yield, three important considerations [illegible] the experiment must be simple and definite and capable of giving a clear " yes " or " no " answer: it must be based on knowledge that is trustworthy as far as it goes; and the results must be interpreted if they are to be of wide use to farmers. The interpretation may well lead to a good deal of discussion, indeed it is usually a mark of a good investigation that it does give rise to controversy.

Results Obtained.—A well-planned field experiment often gives more information than its designer anticipated. A classical example is the Broadbalk wheat field which was laid out in the first instance to ascertain the manurial requirements of the wheat crop. Stated in this form the problem is too indefinite for field experiment, but the genius of Lawes and Gilbert reduced it to three simple questions. They started out (as we have seen is always essential) from certain definitely known facts, viz.:—

(1) That farmyard manure is an excellent manure for wheat.

(2) That farmyard manure contains three groups of constituents: (*a*) ash constituents, (*b*) nitrogen compounds, (*c*) organic matter, and they proceeded to ascertain which of these were effective for wheat. Their plan of experiment was as follows: four plots were measured out on Broadbalk field; one was left without manure; a second received farmyard manure at the rate of 14 tons per acre; a third received the ash constituents of farmyard manure at the same rate; while a fourth received the ash constituents together with the nitrogen compounds (actually ammonium salts obtained from gas works). The plots were then sown simultaneously with wheat, and the resulting crops were weighed; the results were as follows:—

Produce of Wheat per Acre. Broadbalk Field, Rothamsted, 1844.

	Yield per Acre. Grain.	Yield per Acre. Straw.
No manure	16 bus.	1,120 lb.
Farmyard manure (14 tons per acre)	22 ,,	1,476 ,,
Ashes of 14 tons of farmyard manure	16 ,,	1,104 ,,
Ash constituents + a nitrogen compound (ammonium sulphate) up to	26½ ,,	1,772 ,,

Comparison of the yields from the first and second plots showed the effect of farmyard manure; this was the standard against which the other yields had to be measured. The third plot put the question whether the ash constituents were the effective fertiliser; the answer is clearly " no," since the yield is no better than that on the unmanured plot. The fourth plot put the question whether the ash constituents *plus* nitrogen compounds were the true agents, and the answer is " yes "; it was made more definite by further experiments which showed that nitrogen alone was not as effective as nitrogen *plus* ash constituents. Lawes and Gilbert drew the immediate conclusion that these substances could take the place of farmyard manure, and Lawes set up a factory at Deptford to prepare them on the large scale. The experiment was one of the foundations of the artificial fertiliser industry and might therefore have been regarded as finished. It was, however, continued by Lawes and Gilbert, and also by the subsequent directors, first Sir Daniel Hall and then the writer, and there is little doubt that future directors will do so for the very sufficient reason that it continues to give useful information. The plots have been found very valuable for studies in soil chemistry; microbiology; soil physics; for important field problems connected with drainage, draft of tillage implements, etc.; they have helped considerably in studying problems connected with the cultivation of the prairie lands of Canada and the United States, especially the very difficult problem of the rapid loss of nitrogen when the prairie is first broken up; and it seems improbable that a time will ever come when the experiment can be described as finished. It was started in 1843 and maintains its value as the years go by.

Carrying out a Field Experiment.—We must turn now to the consideration of the way in which a field experiment should be carried out, assuming the plan is satisfactory.

I.—The first method used was the side-by-side arrangement of plots familiar to those who know the Broadbalk field. There were single plots only for each treatment, but the experiment was repeated year after year on the same ground, *i.e.*, repetition in time though not in the field. Lawes and Gilbert published their results after a period of 20 years, though, as a matter of fact, substantially the same conclusions can be drawn from the first five years' results.

The method has the drawback that it takes no account of variations in the soil. Had the plot receiving ash constituents

and nitrogen compou...
rest so that it yielde...
Lawes and Gilbert would have concluded that the organic matter was the essential fertilising ingredi...
covery of the great value of artificial fertilisers might have been delayed. They recognised the difficulty about soil variation, and repeated the experiment at certain other centres; at Holkham in Norfolk; at Rodmersham in Kent; and after many years at Woburn.

Admitting this weakness in the method, its advantages are that it is the simplest of all arrangements for field work, so simple that it can easily be carried out on a commercial farm, and it lends itself easily to demonstration, especially when the plots can be arranged end-on to a road so that farmers can assemble to see the results. Yet it can only be recommended :—

(1) Where the experimenter knows pretty well what result he will get, and it is reasonably sure that the differences will be visible to the eye (usually the difference must be 15 to 20 per cent. to be visible, and preferably more to make a good demonstration);

(2) Where the experiment must of necessity be carried out on a commercial farm and it is impossible to arrange for more than the minimum number of plots.

In this case the experiment must be made on uniform lines, at a number of centres with fairly large plots, on fields known to the farmer as being uniform. But it must also be made at the same time at one or more College or Research Station Farms properly replicated as described below. These form the "key" experiments from which the critical information is derived; the commercial farm experiments can be interpreted only in the light of the information they give.

An example of this method of experiment is furnished by the investigations on malting barley carried out by Rothamsted as part of the Institute of Brewing Research Scheme. The purpose of the experiment is to ascertain the influence of manures on the yield and malting quality of barley. It involves testing the effect of a complete mixture of artificial manures and of the mixture without nitrogen, without phosphate and without potash respectively. At Rothamsted the experiment is fully replicated, and also, though to a less extent, at Woburn, but it is an essential part of the scheme that it should be repeated by a number of commercial farmers

known to be good barley growers, so that their observations and those of their barley buyers should be obtained. On these farms it is impracticable to have more than a few plots; five can be properly looked after and fairly accurately weighed, but 10 or 15 would be impossible. Five single plots of an acre each are therefore used; the seed for all centres is the same, as also are the manures; all are sent out from the central supply. On each farm the scheme is repeated without change for three or four years, the barley coming in its proper place in the rotation. In addition, at one of the more interesting centres (Wellingore) it has been found possible to repeat on the same field for three years. Worked in this way on a uniform basis for a period of four years, with the "key" experiments at the Research Station, the method gives good results, some of which are summarised below:—

DECREASE (—), OR INCREASE (+), PER ACRE DUE TO OMISSION OF CERTAIN FERTILISERS FROM THE COMPLETE MANURE.

Fertiliser omitted from complete manure.		*After a Straw Crop.*	*After Roots fed off.*	*After Potatoes or Beet (well manured).*	*Mean of all Experiments.*
		Bus.	Bus.	Bus.	Bus.
1 cwt. sulphate of ammonia	...	— 5.8	— 3.9	— 6.7	— 5.4
3 cwt. superphosphate ...	...	— 0.9	+ 0.5	— 1.2	— 0.5
1½ cwt. sulphate of potash	...	+ 1.1	— 1.3	— 1.1	— 0.3

On the basis of these experiments it would be safe to tell a class of students or a body of farmers in a lecture that an increase of some 4 or 5 bushels of grain could be expected as a result of applying 1 cwt. sulphate of ammonia and that the Table of Valuations shows that no reduction in value per quarter need be feared; that neither superphosphate nor potash would generally increase either yield or value per quarter to any important extent. Yet it would not be safe on this basis to advise an individual farmer on his own farm unless one happened to know the farm; the direct test would always be desirable.

II.—Lawes and Gilbert devised a second lay-out for field experiments in which one set of treatments is applied in one direction and the other set in the cross direction, so giving a number of rectangular plots arranged like a chess-board. (Fig. 1.) This method was used for the Hoos barley experiments begun in 1852. It is more compact than the side-by-side arrangement and is therefore more trustworthy, but it is not well suited to demonstration to large parties of farmers. It

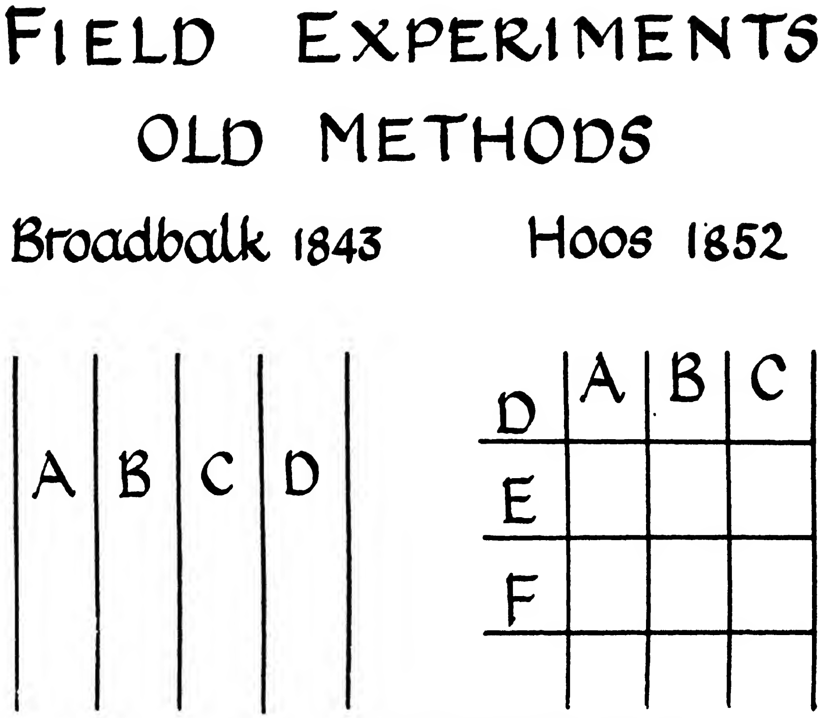


FIG. 1.—Side-by-side and Chess-board arrangement of Field Plots.

involves the danger that the experimenter may put in too many treatments; he may think it quite easy to test 16 or even 20 schemes; actually no experiment should involve more than four or five. A useful type of experiment on this model is to test the effect of fertilisers on different varieties of the same crop. The different varieties can be set along the strips, A, B, C, while the manurial treatments are given along the cross strips, D, E, F. The set needs to be repeated without change for several years, and on several fields or parts of the same field.

The Hoos barley plots, like those of wheat, are repeated year after year on the same ground, and so the variations due to season can be allowed for, but not the variations due to soil. These give an element of uncertainty which no length of time of continuance ever quite removes. Variations in soil can be overcome only by repeating the experiment on the same field at the same time. This is now well recognised, and duplicate experiments have long been the rule. There is, however, one important point about duplication. The duplicate plots must not follow in the same order as the first set. If two treatments or varieties which we may call "A" and "B" are being

compared, it is not sufficient to arrange them alternately thus:

A B A B A B etc.

For the A's are always to the left of the B's, and will always come out better if the fertility of the land is falling off from the left to the right of the plots, or worse if the fertility slope runs the other way. Several instances could be quoted from published reports where plots so arranged have given misleading results: A was pronounced better than B, and the repetitions made the result look true, but in truth A was no better than B and the result was due to a difference in fertility.

The proper way to arrange a comparison between two treatments is to arrange them on a balanced plan, thus:

A B B A A B B A

Here each treatment is compared with itself on one side and the other treatment on the other side, and the plots are equally balanced about the centre. Whichever way the fertility may be varying the comparisons can still be made. This is the method used first by Dr. Beaven and now by the Institute of Agricultural Botany for testing varieties of crops; it is often called the half-strip drill method because half the drill carries seed of variety A and the other half carries seed of variety B: as the drill goes up and down the field, it sows strips as shown above. The difference in yield between one variety and another of the same crop may be as little as 5 per cent.; this could not be detected by any single-plot method nor by repetitions on alternate plots; it can, however, be shown on this balanced method.

III.—For manurial trials it is commonly necessary to have more than two treatments; usually five are required. The plots can still be arranged on a balanced plan as shown in Fig. 2. They are grouped round a central plot so that the distances from the centre of the plots under each treatment when added up are the same both on the left and on the right side. Thus, in the diagram B is the centre (it is marked 0). Under treatment A there are two plots to the left, distant respectively 1 and 6: total 7: one plot to the right distant 7. Under treatment C there is one to the left distant 7; and two to the right distant 2 and 5: total 7. Under D there is one to the left distant 5 and two to the right distant 1 and 4: total 5. This method overcomes some of the difficulty of soil variation, especially the small steady changes imperceptible to the eye.

The plan can be simplified by using a cross dressing. An instance is afforded by the experiment designed by Mr. R. A.

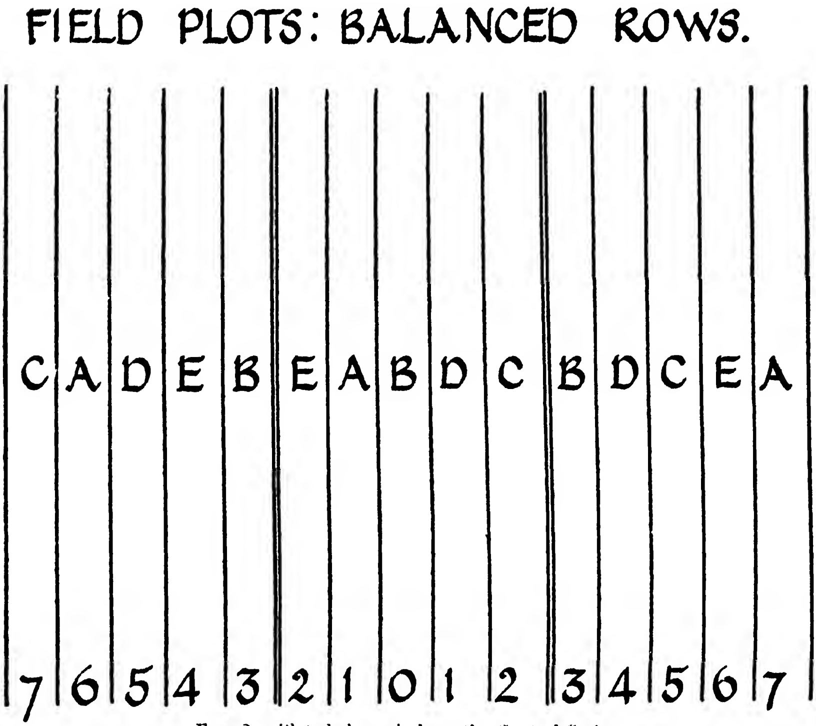


FIG. 2.—Plots balanced about the Central Strip 0.

Fisher for a detailed study of the effect of phosphates and of nitrogen on crop yield. Considerable accuracy is necessary because the data are to be used for studying the influence of the weather on the effectiveness of the manures. The plan is shown in Fig. 3. The whole area receives a potash fertiliser; the influence of potash cannot in this particular experiment be studied. The area is divided into " balanced " strips for the phosphate dressings, then it is cross-divided into two; the opposite corner groups receive nitrogenous manures, the others do not. The set involves 16 plots, but the agricultural operations can be managed without much difficulty.

IV.—A still better plan would have been to arrange the nitrogenous manures also in " balanced " strips similar to those used for the phosphate, but this would have necessitated 64 plots, an impracticable number for this particular experiment.

V.—Another modification consists in arranging the triplicates not side-by-side as in Fig. 2, but chess-board fashion as in Fig. 4. The numbers on the plots represent the various treatments. It will be observed that they " balance " about a line

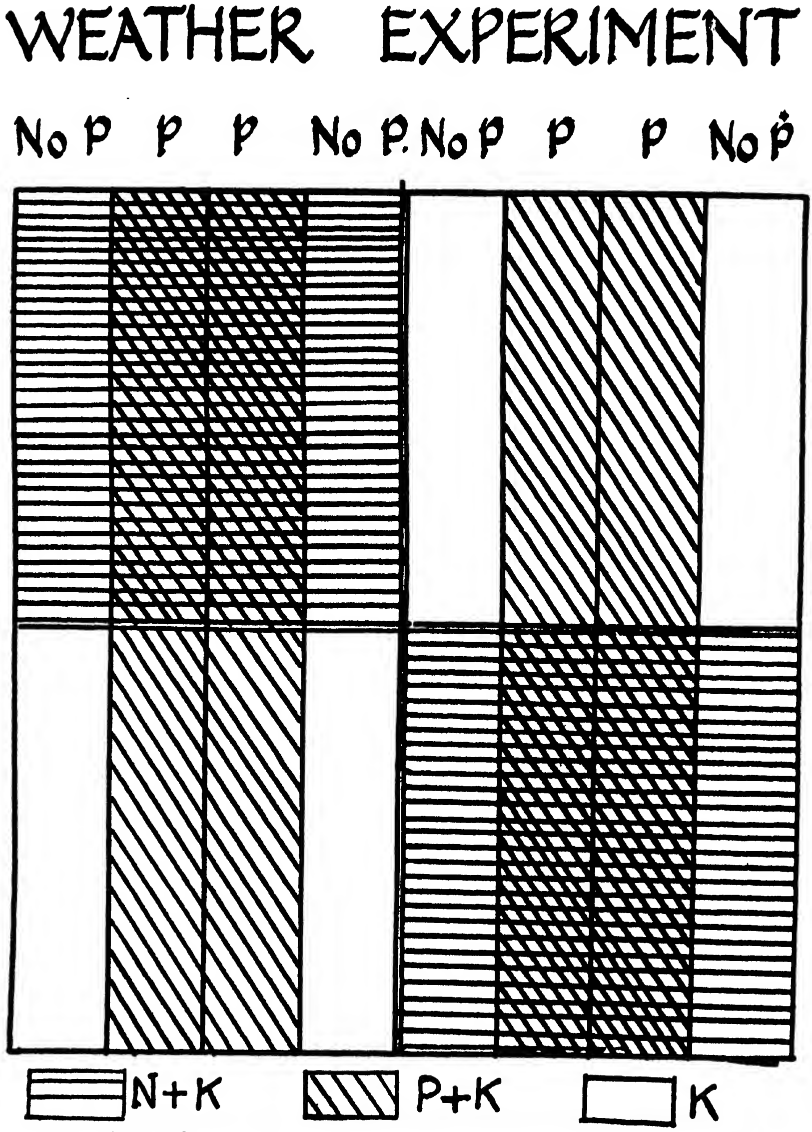
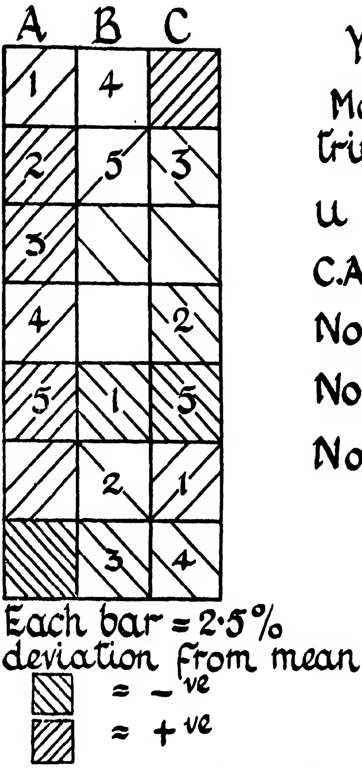


FIG. 3.—Balanced arrangement of Plots for studying the Influence of Weather on the Effectiveness of Phosphates and Nitrogen.

drawn across the middle. The shading of the plots shows the fertility variations as revealed by a "uniformity" study of the figures. The mean of the triplicates shows an increase of 7.8 bus. per acre for the use of 1 cwt. sulphate of ammonia, no appreciable result from the use of superphosphate, and a gain of 5.4 bus. per acre by omitting potash from the manurial

MALTING BARLEY TRIALS
ROTHAMSTED 1924



Yield, bu. per acre

	Mean of triplicates	Selected zones Good (A)	Poor (B.C)
U	25·8	27·2	22·6
C.A	29·8	33·7	29·0
NoK	34·4	38·9	31·5
NoP	30·7	32·4	28·7
NoN	22·0	25·6	

FIG. 4.—Balanced Plots on Chess-board Plan.

dressings. This last result is very interesting: it is obtained if one studies the whole group of plots, or if one considers only the best plots or only the worst; the chances are very remote that it is due to some accident such as soil variation. It is not obtained every year, and is not therefore a regular behaviour of soil or crop, but some peculiarity of the season. The experiment gives no information as to *why* this happened, but shows clearly and certainly that it *did* happen. Laboratory investigations are needed to discover the causes at work; until these are known it is impossible to predict when the result is likely to happen again.

The " balancing " of the strips has the great advantage that it very considerably reduces the errors due to irregularities of the soil. With single plots it is difficult on one year's trial to

speak confidently of a difference of 10 per cent. in the yield, though if the same result is obtained for three or four years it becomes more certain; but with replicated "balanced" strips the results have a much greater value even in one season.

VI.—A further refinement is now being introduced at Rothamsted in consequence of the investigations of Messrs. R. A. Fisher, T. Eden and E. J. Maskell. The strength of the balanced strip method is that it reduces to a minimum the errors due to soil variation. Its weakness lies in the fact that the errors, though certainly small, are not definitely known; they cannot be calculated accurately. The investigator desires not only to minimise his errors, but to know how big they are. The amount of error, or rather the probable amount, can be calculated, but the calculation assumes that there has been no adjusting of the figures or selection of the ground for a particular plot; everything must have been left to chance. In practice this is impossible and a certain amount of selection is necessary; a compromise has to be made between what is desirable and what is practicable. The best practicable arrangement is to have as many repetitions as there are treatments, to set the plots out in chess-board fashion, but arranged so that no two of the same kind come in the same column or in the same row; the arrangement is called a "Latin Square": an example is as follows:—

A B C
C A B
B C A

For a manurial experiment with five plots there are no fewer than 1,344 possible arrangements. (Fig. 5.)

In laying out an experiment on these lines the fact that no treatment is repeated on any one row or column gives all the advantages of the "balanced" strips. The fact that there are 1,344 ways of arranging the plots within the square allows ample play to the laws of chance. For the investigator does not himself choose which of all these ways he will have; each arrangement is written on a separate card, the pack of 1,344 cards is shuffled and one chosen at random; this is the arrangement adopted. As a still greater refinement three or four are chosen and all are used.

Obviously the method requires a considerable number of plots. Its use at Rothamsted necessitates special arrangements for harvesting, thrashing, weighing and recording, which, however, are too intricate to be dealt with here. The advantage

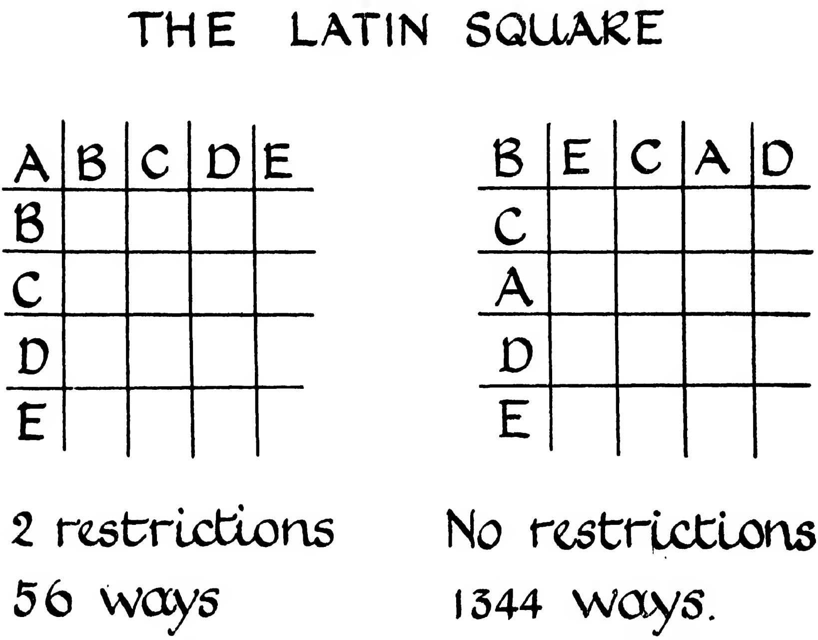


FIG. 5.—The best arrangement known at present for Testing 5 Treatments.

of the method is that the errors are reduced to a very small quantity, and that quantity can be calculated so that the statistician can apply proper statistical methods to the treatment of the results.

The planning of a field experiment which is intended to yield new knowledge is obviously no easy matter. The staffs of the Rothamsted Statistical and Field Experiments Departments are always ready to discuss experimental schemes with Organisers and College Lecturers who wish to carry them out with a view to increasing the value of the experiment without detracting from its practicability.

WINTER "BURN" (OR "BROWNING") OF HERBAGE PLANTS.

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IN connection with the work on herbage plants at the Welsh Plant Breeding Station it has been noted that when grasses commence to burn in the autumn they soon become unpalatable to stock and tend to be neglected—indeed, in the case of many species, cocksfoot for example, a state of relative unpalatability appears to set in before visible signs of burn. Autumn and winter colour changes have also been observed to occur in many grasses. These are sometimes, but not necessarily, the forerunners of definite burn and like true burn are associated with lessened palatability. Rough-stalked meadow-grass, for instance, tends to change from olive-green to reddish-purple with the advent of winter, while the leaves of species like Timothy and the ryegrasses frequently develop purplish colorations.* These colour changes, like burn itself, are most pronounced under severe conditions and at high elevations.

It is not proposed in this article to discuss in any detail the physiological aspects of the question. It will be shown, however, that relatively adult leafage burns far more readily than young leaves, and that stem leaves burn more freely than root leaves. This is interesting in view of the recent work of Dastur† which seems to suggest that burn is due to an insufficient amount of water reaching the assimilating cells of the leaf, a state of affairs which appears to be determined by the fact that the inherent conductivity of the water-carrying elements does not increase in proportion as the leaf augments its surface area approaching maturity.

Colour-changes and burn in grasses are no doubt analogous phenomena to autumn tints and leaf fall in deciduous trees—indeed the Blue Moor Grass (*Molinia caerulea*) is a completely deciduous grass. The dead leaves become detached from the stools during a comparatively short period and these blowing in the wind have given the additional name of " Flying Bent "

* It is possible that these purple colorations—particularly when they occur, as they not infrequently do, during the growing season—are in some cases due to paucity of available phosphates. This was suggested by Dr. Hanley when he was looking over a series of our plots " with " and " without " basic slag early in the summer.

† Dastur, H. T. " Water Content. A Factor in Photosynthesis " : *Ann. Bot.*, XXXVIII, pp. 776-788, 1924 ; and "The Relation Between Water Content and Photosynthesis," : *ibid.*, Vol. XXXIX, pp. 768-786, 1925.

to the grass. In the case of most grasses, however, the dead leaves remain long attached to the plant—in a manner similar to that often seen on beech hedges—and possibly afford a certain protection during the winter and may therefore be an aid to over-wintering.

In this connection it is interesting to remark that in the case of cocksfoot (many thousands of plants of which species have been studied at the Station) it has been those plants obtained from the most exposed situations that have displayed the greatest degree of winter burn. Thus when plants taken from exposed cliff tops at Tintagel in Cornwall and from the highest elevations in the Welsh hills have been grown in beds at the Station alongside other plants taken from more sheltered situations it has been the plants from the exposed habitats that have shown by far the greatest burn. Since the contrast has been so well marked and repeated to the same degree year after year this can hardly be coincidence—and significant too is the fact that Timothy plants from ordinary North American commercial seed tend to be more winter burned than those of indigenous origin. The point of economic importance is, however, the evidence thus afforded that different strains of one and the same species of grass differ widely in the extent to which they winter burn, and this will be further emphasised when discussing the data that have been collected at the Station.

It is with the economic aspects of the phenomenon of winter burn that this article is primarily concerned. Careful notes have been taken during the period 1921-25 on a number of the experiments in progress, both in the case of mixtures and of species grown in pure cultures. Burn has been estimated on a scale of marks 0—10 (10 = most burn) in the majority of the experiments, but in a few cases it has been accurately measured by cutting off the burned from the non-burned portion of the leaves and by oven-drying and weighing the separations thus made. The evidence accumulated will be briefly discussed under appropriate headings.

Amount of Leafage in Relation to Burn.—Twenty different strains and species of grasses were grown in pure plots replicated six times (E 37)* and subjected to different systems of cutting. The herbage on four of the replications was cut on 8th October,

* Figures in brackets represent the Station reference number to the experiment or trial concerned.

1925 (second harvest year), and the burn was accurately measured.

The results fall into three series, two being aftermath (after hay) and one being a monthly pasture cut. Owing to previous treatment one of the aftermaths gave a decidedly heavier yield than the other and both substantially outyielded the pasture, so that the figures show the relation of burn to amount of leafage present. Average results are given in Table I.

TABLE I.—To show the average percentage of Burn for twenty strains and species of Grasses (oven dry weight determinations) in relation to the yield of produce. Cuts made on 8th October, 1925 (second harvest year).

Treatment.	*Percentage Burn.*	*Relative with burn of heaviest aftermath* = 100.	*Relative yield of produce with heaviest aftermath* = 100.
Pasture cut	27.1	50	27
Light aftermath cut ...	47.0	87	78
Heavy aftermath cut ...	53.6	100	100

It will be noted in the first place that burned foliage contributes very largely to the whole, even as early as 8th October: in the pasture cuts, the lowest figure recorded was 11.6 per cent. for crested dogstail,* while in the aftermath the lowest figure was 22.6 per cent. for indigenous tall fescue. There is a perfect gradation in the relative amount of burn from the pasture cut with relatively little foliage to the heaviest yielding aftermath cut.

Results obtained on single plants have shown that in the case of pasture cuts compared with each other the amount of burn is directly proportionate to yield. Sixteen strains and species of grasses (grown as spaced single plants: B. 122) were cut on 17th March, 1924 (first harvest year)—the produce representing the growth since 16th February of the same year. An "A" series had been previously cut three times and a "B" series but twice; the yield of the "B" series was nearly three times that of the "A" series. The percentage burn was in each case as under:—

"A" series—lowest yield: burn 12.6 per cent. by wt. oven-dried separations.
"B" series—highest yield: burn 22.9 per cent. " " "

In the case of every strain and species under test, and in both the sets of data referred to, the greatest amount of burn was recorded from the highest yielding unit.

* This figure was somewhat too high owing to the herbage containing a certain proportion of stubble from the previous cut, see p. 1006.

Evidence in a similar direction was obtained from a number of other experiments. Thus plots of the ryegrasses (B. 101) allowed to grow on to aftermath after hay compared to plots kept grazed showed the following differences on 18th October, 1924 :—

	Burn on a scale 0—10.	
	Aftermath (tall).	*Pasture (short).*
Italian ryegrass	8	1
Perennial ryegrass	8	3

Further instances may be quoted from observations on 13th March, 1925, on old leys and permanent pastures, when comparisons were made between closely-grazed portions of the fields and neglected clumps. The figures hereunder (the average of a large number of notes) on a scale of marks speak for themselves :—

	Grazed portions.	*Ungrazed clumps.*
Cocksfoot	2	8
Yorkshire fog	2	6
Bent...	5	10

An interesting difference was noted in the case of tall oat-grass on plots producing aftermath after hay (B. 139)—the aftermath being allowed to stand until 6th December, 1925. The French tall oat-grass had made tall and stemmy growth and produced a few panicles; the indigenous strain had only produced root leaves. The burn on a scale of marks was :—

French tall oat-grass (stem leaves)	10
Indigenous tall oat-grass (root leaves)	3

The facts given above are sufficient to show that it is an invariable occurrence for burn to be excessive in proportion as the foliage becomes more and more mature, and that this applies to all species alike. This is a point of considerable economic significance, for it is a very common practice to allow pastures to pass into the winter in an under-grazed and tufted condition, while in some districts aftermath is left standing as foggage to provide winter keep. These practices may possibly be justified under certain conditions, but they entail an enormous amount of waste, and animals will not take the burned foliage as long as anything green is available. If the pastures are kept grazed they will remain relatively green, and even during the winter, will develop more green and succulent keep than is perhaps generally realised*—in any event all that

* At the Plant Breeding Station the pastures are always kept well grazed, and their winter carrying capacity is remarkably high. It is true that most of the pastures are high-class temporary leys and that Italian ryegrass is largely grown, but the keep thus assured is incomparably higher than could ever be achieved by any system of foggage.

is developed will be palatable and nutritious. The case against dried and burned herbage is greatly strengthened by chemical analyses recently made by Fagan and Jones,* who have shown in the case of cocksfoot, for instance, that burned leaves contain hardly half the amount of crude and true protein as green leaves, while they contain more fibre and about five times as much silica (SiO_2).

Comparisons between the Species.—From what has been said in the previous paragraphs it will be apparent that the species can only fairly be compared when in similar stages of growth, and—since grazing is usually differential—absolute comparisons are of course difficult. Typical results are given in Table II, and these have been based wholly on leaf burn, no account having been taken of old stubble, dried stems and creeping runners which in the case of bent, for example, greatly add to the total amount of burned tissue. The results have been given on the scale of marks basis partly because the greatest number of comparisons have been made by this method and partly because it is not always easy to differentiate between stubble (from a previous cut) and normal burn when making separations on cut herbage and this is particularly so in the case of the slow and short growing grasses like rough-stalked meadow-grass and crested dogstail, which always contain an unduly large proportion of stubble in samples obtained by close cutting.

Normal winter burn should not be confused with the effects of fungus attack, although in the middle of the winter it is not easy to differentiate between " normal " and " fungus " burn. Fungus " burn " is chiefly due to rusts, and sets in earlier in the autumn than normal burn.† The chief grasses to be affected in this way are:—

Perennial ryegrass	by	*Puccinia Lolii.*
Timothy	,,	*P. Phlei-pratensis.*
Meadow foxtail	,,	*Mastigosporium album and P. perplexans.*
Cocksfoot	,,	*M. album var muticum and P. glumarum.*
Sweet vernal grass	,,	*P. Anthoxanthi and Uredo Anthoxanthina.*

The various strains of the different grasses show marked differences in susceptibility to attack. Plants badly attacked

* See Fagan, T. W., and Jones, H. Trefor, "The Nutritive Value of Grasses as shown by their Chemical Composition": Welsh Plant Breeding Station Bulletin, Series H, No. 3, 1924.

† For further particulars see notes by Miss K. Sampson in "Preliminary Investigations with Herbage Plants": Welsh Plant Breeding Station Bulletin, series H., No. 1, 1922.

show very high percentages of burned and dead tissue as the autumn advances.

In the case of Timothy (single plants, 1924, B. 122) commercial plants badly attacked by *Puccinia Phlei-pratensis* showed dead tissue in the early winter to the extent of 61 per cent. of the whole, while healthy indigenous plants showed only 11 per cent. In the early winter of 1925 (B. 139) the Norwegian perennial ryegrass "Jaedersk," highly susceptible to *P. Lolii*, gave a "burn" figure (on scale of marks) of 10, while indigenous strains not attacked by rust during the autumn showed real burn figures ranging only from 3 to 6.

It is possible in respect of meadow foxtail and sweet vernal grass that the figures given in Table II may have been exaggerated by rust, but in the main the results presented may be safely taken as having been solely due to normal winter burn.

The most striking fact brought out by the figures is the slight extent to which the clovers winter-burn. White clover is almost absolutely winter-green under ordinary pasture conditions in Wales. Red clover only burns appreciably when aftermath is left uncut or ungrazed, when it will become completely burned with the advent of frost; if kept normally well grazed it is, however, practically as winter-green as white clover. Yellow suckling clover has a decided tendency to burn slightly; it may be added that subterranean clover is wonderfully winter-green and only burns when approaching to maturity.

It will be seen that there is a considerable range of burn amongst the grasses. On one series of plots, rough-stalked meadow-grass decayed rather than burned, but, taking the data as a whole, and particularly having regard to the behaviour of this species in mixtures, it is undoubtedly one of our most winter-green grasses.* The two ryegrasses, crested dogstail and rough-stalked meadow-grass, are the outstanding winter green species—and are therefore to be regarded as the most important ingredients in a sward for the critical period October-April. Meadow foxtail, the fine-leaved fescues and cocksfoot are species which not only tend to burn very badly but which usually start to burn comparatively early in the autumn. Bent and *Phalaris arundinacea* are both species which burn particularly badly, and the little evidence available suggests that

* *Poa annua* is of course an exceptionally winter-green grass, and despite its small bulk might well prove to be a valuable species for providing succulent winter keep.

TABLE II.—To show for Twenty-two species of Grasses and Clovers the Amount of Winter Burn on a scale of marks, 0-10 (10 = most burn). The data are based on observations made during the period September-March on a number of trials in progress at the Welsh Plant Breeding Station.

The Species.	E.37 pure plots. 1924 12/2	E.37 1924 4/11	E.37 1925 15/1	E.37 1925 1/10	E.28 pure plots peat. 29/9/24	B.101. pure plots* 18/11/24	B.139 pure plots. 12/3/25	B.139 * 5/9/25	B.139 * 5/12/25	Perm. Pasture. Orchard Fld. 15/3/25	Various temporary leys. 15/3/25	‡ 15/3/25	§ 15/3/25	15/3/25	15/3/25	Average Figure.
Perennial ryegrass ...	0	0	1	2	0	5	3	2	6	1	2	3	0	2	2	1.9
Italian do. ...	0	0	1	2	–	4	–	–	–	–	3	2	–	1	3	1.8
Cocksfoot	2	6	5	7	6	8	6	6	8	7	8	8	3	8	–	6.3
Timothy	4	1	2	4	7	7	3	6	8	–	–	7	1	3	2	4.2
Meadow fescue ...	2	2	4	2	1	4	4	2	9	–	3	7	–	4	–	3.7
Tall fescue	2	3	7	2	–	4	5	4	10	–	–	8	–	7	–	5.2
Fine-leaved fescue ...	2	8	7	9	-	–	6	6	10	4	–	7	3	7	4	6.1
Meadow foxtail ...	3	7	7	8	9	8	6	5	7	–	4	7	–	6	–	6.4
Tall oat-grass... ...	2	1	3	4	–	–	4	6	7	–	–	4	2	2	–	3.5
Golden do.	1	5	3	6	0	4	–	–	–	–	–	–	–	2	–	3.0
Crested dogstail ...	0	1	1	2	0	–	–	–	–	1	–	2	1	–	2	1.1
Sweet vernal grass ...	0	5	4	3	–	–	4	5	10	3	3	–	2	–	–	3.9
Rough-s. m.-grass ...	0	1	1	1	–	–	–	8†	–	0	–	3	0	1	1	1.6
Smooth do. ...	–	–	–	–	–	–	6	7	–	–	–	–	–	–	–	6.5
Phalaris nodosa ...	0	1	2	2	–	–	–	–	–	–	–	–	–	–	–	1.7
P. arundinacea ...	0	7	10	7	–	10	–	–	–	–	–	–	–	–	–	8.5
Yorkshire fog... ...	–	–	–	–	–	–	–	–	–	5	–	–	–	3	3	3.7
Bent	–	–	–	–	–	–	–	6	–	10	9	–	6	6	8	7.5
Red clover	0	0	0	trace	1	3	–	–	–	–	0	–	–	–	–	neg.
Alsike clover	0	0	0	0	–	–	–	–	–	–	–	–	–	–	–	neg.
White clover	0	0	0	0	0	-	–	–	–	0	0	–	–	–	0	neg.
Yel. suckling clover ...	0	–	–	–	–	–	–	–	–	–	2	–	–	–	2	2.0

* Relatively tall growth.
† Browned and decayed rather than normally burned.
‡ Wet field.
§ Dry field.

smooth-stalked meadow-grass is to be ranked with the least satisfactory species in this respect. It is interesting to note that Yorkshire fog takes its place with species like meadow fescue, tall oat-grass, Timothy and sweet vernal grass, which occupy an intermediate position as to burn. Tall fescue, although not starting to burn quite as early as cocksfoot and meadow foxtail, soon assumes an almost equally burned appearance.

The relative winter green of perennial ryegrass, compared with cocksfoot and meadow foxtail, is well shown by the actual percentage of burn from three typical pasture cuts (E. 37) :—

BURN AS PER CENT. BY WEIGHT OF OVEN-DRY SEPARATIONS.

	Average of cuts 11/3 and 16/4/1924.	*Cut on 8/10/25.*
Perennial ryegrass ...	28.5	16.7
Cocksfoot	43.0	31.2
Meadow foxtail ...	65.5	28.9

Burn in Relation to Conditions.—Wet and water-logged conditions tend greatly to exaggerate burn. Notes were taken early in 1925 on a wet field and on a dry field, both of which had been grazed about equally. The results are shown with the other data in Table II. In the case of all species the burn was decidedly greater on the wet than on the dry field. Similar results were obtained on a number of fields during the wet season of 1924 It has been stated in the introduction that exposure also favours burn. This is well seen in upland sheep walks, sheltered hill-sides remaining relatively green although consisting chiefly of fine-leaved fescue and bent, while the exposed areas covered by the same species are completely winter-brown.* A further example may be quoted. A particular strain of meadow foxtail was sown on two exposed hill farms and on a sheltered lowland field. At the high elevations, although appreciably grazed, the amount of burn was very considerable (December of seeding year), while on the sheltered field, although not grazed, the amount of burn was negligible.

Bent in Relation to the Burn of a Pasture as a Whole.—It has been shown that bent is perhaps the most winter-burned of all our ordinary pasture grasses, even when only leaf burn is considered, but, when old, dry and neglected stems and runners are also taken into consideration, there can be not the least doubt that the brown and unproductive condition of our pas-

* The winter burn on the exposed situations is, however, often accentuated by the fact that the grazing is not so close during the late summer and early autumn as on more sheltered hill-sides.

tures in winter owes more to bent than to any other species. It was possible [illegible] of bent with very fair accuracy in [illegible] mixture experiment (E. 19). A large [illegible] tested in quadruplicated plots. These were set out in four sections on sloping ground. By the third harvest year bent, in very large amount, had come in at the bottom of the field and in much less amount at the top. The top and bottom sections, therefore, afford a marked contrast in respect of bent domination. Burn was estimated on all the plots on 25th January, 1924 (third harvest year) and, as the standard of comparison, unsown plots completely dominated by bent and fully winter brown were marked at 100. The essential results are given in Table III.

TABLE III.—To show the effect of Bent domination on the winter burn of swards as a whole. Pure bent plots with full winter burn are marked at 100 and the burn on all the other plots expressed as a percentage of these fully burned plots.

Synopsis of Mixtures.	*Top section relatively free from Bent.*	*Bottom section largely dominated by Bent.*
Unsown plots (control) now dominated by Bent ...	100 (all Bent)	100 (all Bent)
Complicated mixtures with Ryegrass	25	37
Complicated mixtures without Ryegrass	34	57
Pasture mixtures with Wild White Clover	30	43
Simple mixtures: Clovers and one grass	41	57

It is seen from the table that in all cases the bent-dominated plots (bottom section) were far more winter-burned than the plots not completely dominated by bent (top section). During the winter the sheep have always tended to collect rather on the top than the bottom series, although the bottom plots have had an appreciable amount of green herbage to offer. In a recent article in this *Journal* it has been pointed out by one of the writers* that the herbage actually taken by sheep is very largely influenced by relative accessibility, and there can be little doubt that great excess of completely dry bent covering a sward tends to render such green foliage as is available difficult of access. Striking confirmation of this view was obtained from another field. Many lots of seeds mixtures were sown in 1924 on the upturned sod of a field in very poor condition. From the outset bent largely redominated the sward, and during the winter of the seeding year the field was

* See Davies, Wm. "The Relative Palatability of Pasture Plants," this *Journal*, Vol. XXXII, No. 2, p. 106, May, 1925.

mass of dried and ... ly cover ... green foliage of ... an appreciable am... the first winter it was never possible to hold sheep for any length of time on the field. Examination of the sward after the removal of the sheep always showed, moreover, that such green leafage as was available had not been really closely grazed.

This evidence affords a further condemnation of the practice of "holding" herbage for the winter, for bent, like every other grass, will burn in proportion to the bulk present; and it is of course a grass which largely dominates our grasslands. Thus, in addition to loss of grazing due to bent itself burning, there will be the further loss due to the blanket thus thrown over more succulent, less burned and relatively palatable herbage. The outstanding case against bent as a grass of economic value is thus seen to be its excessive potentiality for winter burn, so that, when present in large amount and allowed to grow out of hand, it will render pastures almost worthless during practically six months of the year.

Strains of Grasses in Relation to Burn.—It may be useful to give brief particulars of strain in relation to burn in respect of some of the species of grasses which burn the most readily. Taking the evidence as a whole for all the species there has been a marked tendency for the commercial strains to show a higher degree of burn than the indigenous, but when growth fairly starts in the spring the former strains, since they are earlier to make active growth, tend to throw off the burn more quickly. These facts are shown by the following representative figures for Cocksfoot, Timothy and Tall Fescue (E. 37):—

PERCENTAGE BURN BY WEIGHT OF OVEN-DRY SEPARATIONS.

	11th March, 1924.	*16th April, 1924.*
Cocksfoot: Indigenous	48	35
„ Commercial	59	31
Timothy: Indigenous	34	38
„ Commercial	62	27
Tall Fescue: Indigenous ...	37	21
„ Commercial ...	64	20

Cocksfoot.—A great deal of evidence has been obtained relative to strain in the case of cocksfoot, both with pedigree single plants and aggregate lots sown in beds. With the exception of some indigenous strains obtained from very exposed habitats —previously mentioned—the indigenous and New Zealand plants have been much less burned than the ordinary commercial.

Interesting figures are given in Table IV (B 84) based on the average of 105 plots representing 24 different lots of seed. It will be seen that the results are in confirmation of those given above and, beside showing the greater burning of the ordinary commercial strains, indicate that these "green" more quickly in the spring.

TABLE IV.—To compare on a [illegible] the amount of burn in the winter and [illegible] of Cocksfoot.

[illegible] a scale of marks 0–10.

Nationality and Strain.	*Seeding Year.* 1[illegible]/12/21.	*Second Harvest Year.* 10/4/23.
New Zealand	2.1	3.0
Indigenous	2.3	3.3
Danish and U.S.A.	6.0	2.1
French	7.0	1.0

A large number of pedigree strains were grown in small beds in the gardens (B. 139). The beds were marked for burn on several different dates. The results hereunder for 5th December, 1925 (1st harvest year) are typical, are in striking confirmation of those previously given, and serve to show the wide range that exists as between strain and strain.

Indigenous ...	(12 lots)	range of burn per strain	4–10	average	6
New Zealand ...	(4 lots)	,, ,, ,, ,, ,,	4– 7	,,	5
Danish and U.S.A.	(3 lots)	,, ,, ,, ,, ,,	8–10	,,	9

Fine-Leaved Fescues.—Although, taking these fescues as a whole, they burn very badly, yet some of the strains of indigenous red fescue that have been selected at the Station are quite remarkably winter green. Five typical strains subjected to critical test gave a range of burn from 2 to 10. The Chewing's fescue of commerce, although not starting to burn as early as some strains, soon attained to a full burn of 10. Data obtained on single plants (B. 122) on 17th March, 1924, showed hard fescue of commerce with 20 per cent. of the total leafage burned and a selected strain of indigenous red fescue with only 9 per cent. burned.

Bent (Agrostis spp.).—Although critical work has not advanced far with this grass at the Station the strains under investigation have shown wide differences as to burn. Even with *Agrostis*, which in the aggregate burns so badly. notes made on single plants during December have shown some strains with a burn mark of only 1 in striking contrast to those fully burned and marked 10. There is some evidence for thinking that winter-green strains are more likely to be found from amongst *Agrostis vulgaris* varieties than from amongst *A. alba*—the

American red top has shown complete winter burn at Aberystwyth.

Other Grasses.—In all the trials yet conducted indigenous meadow foxtail has been more winter-green than Finnish commercial—typical winter figures being 60 to 75 per cent. burned foliage for the commercial, and 30 to 55 per cent. the indigenous.

[illegible]hough perennial [illegible] green of our grasses, yet [illegible] respect. On the average, commercial plants are little, if any more, burned than indigenous, but the most highly winter-green strains are perhaps to be found amongst indigenous plants. Perennial ryegrass seed cleaned from wild white clover (and presumably indigenous) appears usually to give rise to particularly winter-green plants. This was well seen in the case of plots sown at two hill and two lowland farms last year. When inspected in December the "ex-wild white" plots at all centres showed themselves more perfectly winter-green than plots sown with ordinary commercial seed.

The facts here recorded are sufficient to show that by careful breeding and selection it should be possible to provide the farmer with strains of grasses having a very high resistance to winter burn, and that this should be feasible even with species like bent, cocksfoot, meadow foxtail and the fine-leaved fescues, which normally burn very badly. It remains to be seen whether it will be possible to breed winter-green strains which will also prove highly persistent on very exposed situations on the uplands, and this is a matter now under critical investigation at the Station. The question of foggage would, moreover, have to be examined from a new point of view if it were found possible to select vigorous growing strains which, despite the development of abundant leafage, would yet remain tolerably winter-green: all that can be said at the present is that individual plants of some species, *e.g.*, cocksfoot and meadow foxtail, have shown themselves remarkably tolerant in this respect.

Summer Burn.—During the height of the growing season, grasses and clovers often assume an appearance somewhat similar to that produced by winter burn. These effects deserve passing mention because, as with winter burn, there is evidence for thinking that some of them represent characteristics which are potentially of a hereditary nature, and towards which different strains of the same species respond very differently.

Drying, yellowing and browning of the leaves in summer are undoubtedly due to a variety of causes, but since the extent of these manifestations is often very considerable they are to be regarded as of very real economic importance, and deserve critical investigation. During periods of drought and high wind, adult herbage often suffers from what is probably in effect " winter burn." Other " drying " effects take the form of " tip burn " or " leaf scorch," which are entirely unlike wholesale burn. Cocksfoot in particular is very prone to suffer from these defects, the incidence of which is very different from plant to plant, and is not necessarily associated with particularly unfavourable weather. It would rather seem that they indicate some pathological condition—a " deficiency disease " perhaps; or possibly they are due to an organism and represent something akin to a mosaic disease. Some types of summer burn are definitely due to fungus attack; perhaps the best example, other than the rusts of grasses previously mentioned, is the blackening and dying off of the leaves of Red Clover due to *Peziza*. Browning and yellowing of grasses are occasionally due to virescence, but this is not met with on any considerable scale, being a defect not usually seen in plants derived from normally cross pollinated parents.

Summary.—(1) The phenomenon of winter burn in grasses has been shown frequently to be preceded by certain colour and other physiological changes—these changes and burn itself being associated with decreased palatability. Burned foliage is relatively devoid of nutrients.

(2) Leafage burns in proportion as it is adult; stem leaves burn more freely than root leaves. Pasture grass therefore burns in proportion as it is left tall and ungrazed into the autumn and winter. Pastures kept closely grazed, and particularly if devoid of bent, can therefore be maintained in a state of relative winter-green. The practice of leaving grass as foggage or roughage into the winter is associated with considerable waste and is not ordinarily to be recommended. It is suggested that temporary grass, derived from winter-green species and properly grazed, affords the best means of providing relatively abundant winter grazing.

(3) Bent (*Agrostis* spp.) is one of the most winter burning of grasses and is largely responsible for the brown winter condition of our pastures. Excess of dried bent leafage and stems devoid of all green renders the more succulent foliage of other grasses relatively inaccessible, and is thus the chief factor making for winter unproductiveness of pastures.

(4) The most winter-green of our ordinary pasture grasses are the two ryegrasses, rough-stalked meadow-grass and crested dogstail.

(5) The clovers are wonderfully winter-green: white clover, red clover (if not left tall) and subterranean clover are remarkably so, while yellow suckling clover has a tendency to burn slightly. The clovers, however, make much less winter growth than most of the grasses and altogether less than the ryegrasses.

(6) In addition to bent the grasses with the greatest tendency to winter burn are the fine-leaved fescues, meadow foxtail and cocksfoot, closely followed by tall fescue and French tall oatgrass.

(7) Broadly speaking the indigenous strains of the various species of the grasses are very appreciably more winter-green than the non-indigenous. Relatively winter-green strains are to be met with even amongst the most freely burning species such as bent, the fine-leaved fescues and cocksfoot.

(8) There is some evidence for thinking that strains with a high degree of winter burn are the most successful in maintaining themselves on situations subject to very severe exposure.

(9) Burn is accentuated by wet and water-logged conditions and by exposure.

(10) Certain conditions more or less similar in appearance to ordinary winter burn often reveal themselves in the summer. Effects such as "tip burn" and "leaf scorch" commonly seen in cocksfoot would, however, appear to be manifestations of entirely different physiological phenomena.

* * * * * *

SHEEP DIPPING IN DEVONSHIRE, 1925.

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IN conseqence of the occurrence of sheep scab in the winter of 1924-25, regulations were made by the Devonshire Local Authority requiring the double dipping of all sheep in the County of Devon during the period 7th July to 7th August, 1925. The total number of sheep dipped was 728,547. The breeds included Devon-Long-Wool, Dartmoor, Exmoor, Dorset-Horned, Hampshire-Down and numerous cross breds.

Losses of Sheep.—As 628 sheep are reported to have died in consequence of the dippings it seems important to discuss the cause of this serious loss, which might be put at about £2,500. In addition to the deaths reported many sheep were seriously damaged by casting their wool. Ninety-three died after the first dipping and 535 died after the second dipping. The number affected but recovering after the first dipping was 28; the number affected but recovering after the second dipping was 226.

Samples of Dips.—The police took 111 samples of the solutions used as baths. This sampling was primarily intended to see that the solutions used were of the correct strength as laid down in the regulations, but in consequence of the numerous cases of damage which were reported more importance was attached to these cases. Of the 111 samples which were analysed, 101 contained arsenic and 10 contained tar acids (mainly cresylic acids).

At one farm, arsenic was used for the first dip and tar acid (cresylic acid) for the second; six sheep died, but no sample was taken of the arsenical bath and there was no excess of cresylic acid in the second (see below).

All the deaths reported followed the use of arsenical dips. No deaths were reported in consequence of the use of tar acid dips, although in one case the sheep showed evident signs of irritation by the tar acids, but all recovered; on analysis of a sample taken from this bath, it was found to contain twice the amount of cresylic acid which was necessary or required by the regulations.

From 7th July to beginning of August the weather was hot and no rain fell; this drought probably contributed to the trouble as the arsenic would not be washed from the wool.

The arsenic preparations which were used were all of the same type, containing about 22 per cent. of arsenic and 67 per cent. of free sulphur. Analyses were made of the powder and in no case was there any serious deviation from the correct strength; that is to say, if the quantity of water was as indicated on the packets the strength of the resulting bath would be in accordance with the regulations. The analyses of the samples taken from the dipping baths by the police, however, showed that the concentration of the soluble arsenic dips was twice or three times the required strength in those cases where loss of sheep was reported. In only two cases was loss reported and the baths found of the correct strength, and in these cases

it may be doubted if the sheep which died were dipped in the bath at the time the sample was taken.

Most of the approved dips are sold under fancy names, and only in a few cases is the composition of the article indicated; but when a dip contains arsenic this is stated on the label. Arsenical dips have been used for many years by many farmers without losses, but it seems that considerable risk is attached to their use. In Devon there has been experience of double dipping on a large scale where each sheep owner was at liberty to use his discretion as to the choice of bath, and, whilst the majority were successful, serious losses happened which might have been avoided either by greater care in mixing or by the use of non-arsenical dips.

Ways in which Loss may occur.—There are three distinct ways in which arsenic may be taken by the sheep:—(1) by absorption through the skin, especially in the case of lambs; (2) by the mouth, some of the solution being swallowed by the animal; (3) by being drawn into the lungs through the nostrils, if the animal has been excited or roughly handled. Antidotes would only be of value if used promptly in the second case. As far as can be ascertained the chief damage was caused by absorption through the skin. The most numerous victims appear to have been fat lambs.

It is worthy of note that the great majority of deaths occurred in close-fleeced sheep, such as Exmoors and Hampshire-Downs, only a few deaths occurring in comparatively loose-fleeced sheep such as Devon-Long-Wool. To summarise, the great majority of deaths occurred in close-fleeced sheep after the second dipping, and where an arsenical dip was used at both dippings. From the foregoing it would appear that—

(1) Arsenic is not absorbed to any appreciable extent through the unbroken skin.

(2) The skin may, however, become excoriated by the action of an arsenical dip at the first dipping. This excoriation greatly facilitates the absorption of arsenic when used at the second dipping, with consequent risk to the sheep.

(3) The more arsenic that is retained in the fleece the greater the risk of excoriation of the skin, and subsequent absorption of arsenic.

It is held that a close fleece "holds the dip" better than a loose fleece, this perhaps accounting for the high percentage of close-fleeced sheep in the reported losses.

In one case (see above) losses were experienced where an arsenical dip was used for the first dipping and a tar acid dip was used for the second dipping. A possible explanation of these losses is that the sheep, which were of a close-fleeced breed, retained a considerable quantity of the arsenical dip from the first dipping. This excoriated the skin, and on being redissolved by the second dipping was easily absorbed through the damaged skin.

Warning to Farmers.—From the above it will be seen that there are considerable risks attendant upon the use of arsenical dips for sheep dipping. These risks have been recognised by the Ministry for many years, and warnings have frequently been issued to sheep owners in the form of pamphlets, posters, press notices, etc. In Leaflet No. 61, after prescriptions for three sheep dips have been given, the following appears:—

> The Ministry has not included in the above-mentioned schedule any preparation containing arsenic. It is not to be assumed, however, from this omission that the Ministry does not concur in the view that arsenical dips are thoroughly effective against sheep scab. There is a possible danger to human beings attendant upon the preparation of such dips which renders it advisable that the dip should be compounded by qualified persons only. It is also important to note that a certain amount of risk may be incurred by dipping sheep twice with a short interval in a poisonous dip, and that when a poisonous dip is used for the first dipping it is much safer that a non-poisonous preparation should be used for the second. The Ministry takes no responsibility for any consequences which may arise from the selection of a poisonous dip. Farmers have the choice of a large number of effective non-poisonous dips.

In Pamphlet A.63/T.A., headed "New Responsibilities of Sheep Owners," issued in June, 1923, the following appears on p. 3 under "Poisonous Dips":—

> Arsenical dips may be regarded as effective but, if used, it is safer to use them at full strength for the first dipping only, as prescribed by the manufacturers, a non-poisonous dip at full strength being used for the second dipping.

In a poster headed "Important Notice to Sheep Owners," issued in June, 1923, the following appears:—

> If an arsenical dip is used for the first dipping it is advisable to use a non-poisonous dip at full strength for the second dipping, but if arsenical dips are used for both dippings, the second dipping should be at half the strength of the first dipping.
>
> Persons using poisonous dips must take the precautions necessary for the avoidance of accidents or injury to sheep through the use of such dips, and the Ministry will not entertain any claim for compensation for injury or loss due to their use. The

choice of an approved dip rests entirely with the user. The responsibility for the class of ingredients is a matter for the manufacturer of the dip. The approval of the Ministry only means that the ingredients of a dip are effective for scab in the proportions approved.

A press notice was issued by the Ministry in July, 1920, and the warning contained therein was repeated in a press notice issued in July, 1925, as follows:—

Mortality among Sheep after Dipping.

The Ministry of Agriculture and Fisheries announces that with the development of double dipping for the eradication of Sheep Scab, reports have come to hand from one district of deaths among sheep due to the use of poisonous dips.

The Ministry, therefore, wishes to repeat the warning to sheep-owners, published in the Press, first in July, 1920, and in the Leaflet (No. A.63/T.A.) " New Responsibilities of Sheep Owners," which has been widely distributed by the Police during the past two years.

Where their sheep have to be dipped in pursuance of the Ministry's Orders twice within a period of 14 days all owners are advised that poisonous dips should not for the sake of safety be used for both dippings. In cases where an owner prefers to select a poisonous dip for the first dipping, the Ministry desires to warn him that deaths may occur unless a non-poisonous dip is used for the second dipping. In cases where sheep-owners are prepared to run the risk of using arsenical dips for both dippings, the dip should be used at half its full strength for the second dipping. The Ministry takes no responsibility for any consequences which may arise from the selection of a poisonous dip. Farmers have the choice of a large number of effective non-poisonous dips.

* * * * * *

A COMPARISON OF SCANDINAVIAN AND BRITISH PIG BREEDING METHODS.

II.—SWEDISH METHODS.

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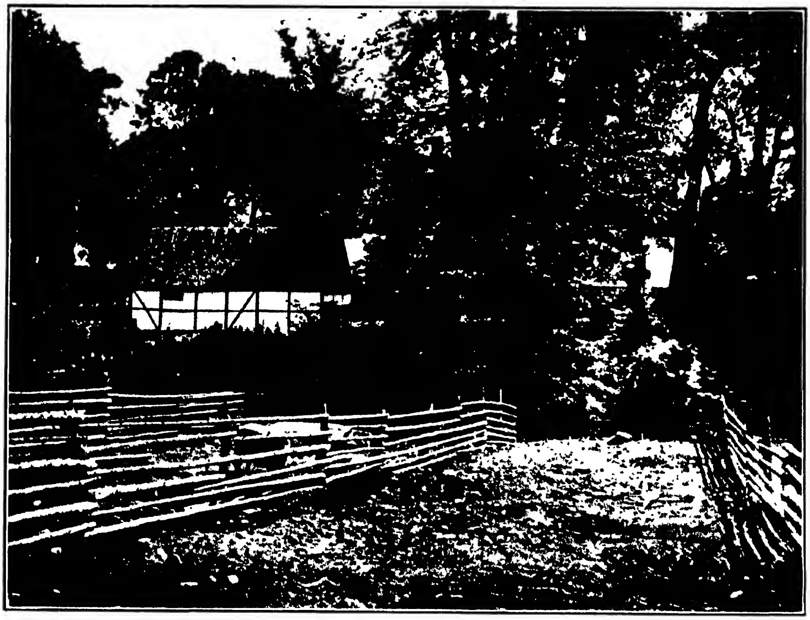
Historical.—In general it may be said that Swedish pig breeding methods approximate much more closely to our own than do those of Denmark, but there are nevertheless some very suggestive differences. It was not until 1900 that co-operative dairies appeared in the country, and these were followed shortly afterwards by co-operative bacon factories. It was then realised that the native pig, previously suitable for the German trade, was not quite suitable for bacon production, both on account of

wrong conformation and lack of purity in breeding. In attempting to overcome this difficulty the Swedes imported several foreign breeds which were known to be pure-bred and which had already been improved in their own countries. The Berkshire, Tamworth and Poland China were tried in turn, but were found unsuitable, and the Swedish authorities state that they found the Large White Yorkshire to be superior to all other imported breeds, both as regards early maturity and the production of first-class bacon. This breed, then, has become the popular one in Sweden, and in the National Herd Book 260 pages are devoted to it, and only 40 to the native "Lantras."

This native breed had become so impure through crossing that the greatest difficulty was experienced in collecting a sufficient number of foundation sows and boars of even type when it was decided to form a herd book for them. In fact boars had to be imported from Denmark, and while the breed is now an established one, it is to all intents and purposes the same as the Danish Landrace.

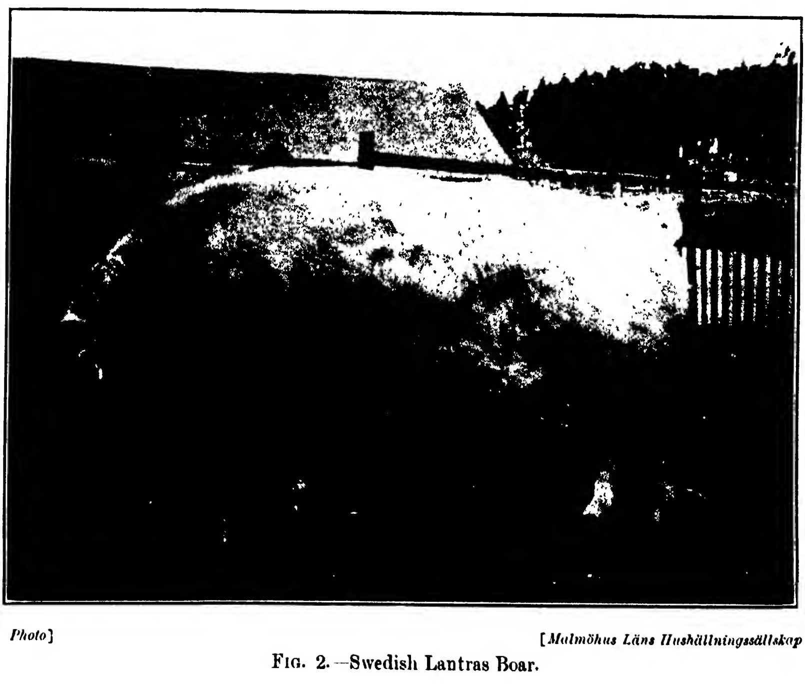
Breeding Stations and Boar Societies.—Since 1897, four breeding stations for Large Whites and two for Lantras pigs have been in existence and these are based on the organisation of the Danish breeding centres. They do not, however, appear to play anything like so important a part in breeding as their Danish counterparts. What is apparently a much more popular means of pig improvement is to be found in the development of what the Swedes themselves term "Boar Societies," but which might more reasonably be called pig control societies. At the end of 1923 there were in the district of Malmöhus alone 89 such societies comprising 2,540 members and 4,325 sows. It appears to be through these societies that the small farmer has been able to improve his pigs, and that the breeding stations, spending comparatively large sums as they have to do in buying expensive foreign pedigree stock, cater more for the large farmer and estate owner.

A small grant from the district agricultural society is given to every boar society formed, and the conditions are that it must consist of at least eight farmers, owning between them at least 20 sows, and that the district agricultural society's representative shall decide of what breed the boar is to be. Though the initial grant is small the societies are assisted by the agricultural society according to a very suggestive plan by



Photo] [*Malmöhus Läns Hushållningssällskap*

Fig. 1.—Swedish Breeding Station at Ofrabyborg, Scania.



Photo] [*Malmöhus Läns Hushållningssällskap*

Fig. 2.—Swedish Lantras Boar.

which the amount of financial assistance is in direct proportion to the quality of the pigs. The society owns the boar or boars, but the sows are the property of the individual members. The societies are subsidised for good quality boars and the farmers for good sows in the following way. Owners of approved sows are awarded two " permits of service " for each sow, which in effect means that two service fees of the society's boar will be paid for by the agricultural society. In order to be approved a sow must not have been served before reaching the age of 8 months, must have at least 12 well-placed teats, and the average number of piglings farrowed at each birth must be nine.

In addition to this, however, a series of prizes and diplomas are awarded both to sows and to boars of outstanding merit. In the case of the sows only a diploma is given, and a " diploma sow " is required to be of exceedingly good conformation, to fulfil all requirements of size and strong development in all parts of the body, to have a satisfactory farrowing record, *i.e.*, an average of 12 pigs in each litter. and to show good breeding capacity as evidenced by her offspring.

These requirements are judged on the following scale of points, of which a sufficient number has to be obtained in order to qualify for a diploma :—

Conformation.	*Max. points.*	
Head and neck	6	
Chest and shoulders	6	
Back and loin	6	
Quarters	6	
Hams	6	
Length and depth of sides	6	
Legs and action	6	
Size and development	6	
General appearance	6	
	—	54
Breeding Capacity.		
Number of teats and conformation of the udder	15	
Prolificacy	15	
Capacity to rear her pigs	16	
	—	46
Total		100

Money prizes instead of diplomas are awarded for the boars, and, with the exception of the fact that a first prize may not be awarded to a boar until he has been proved to be fertile, the prizes are all awarded for points of conformation only.

The following is the scale of points employed:—

	Max. points.
Head and neck	6
Shoulders	6
Chest	6
Back	6
Length of sides	6
Depth of sides	6
Loin	6
Quarters	6
Hams	6
Legs and action	6
Skin and hair	6
Condition	6
Type	8
Size and development	10
General appearance	10
Total	100

A First Class prize (approx. 4 guineas at par) is awarded for 80 points and upwards.

A Second Class prize (approx. £3 7s. at par) is awarded for 67·5 to 79·5 points.

A Third Class prize (approx. £2 10s. at par) is awarded for 55 to 67 points.

District Herd Book.—In order to keep trace of the pedigrees of all breeding pigs, two herd books are kept. The National Herd Book contains only records of pigs which have been bred from parents registered either in Sweden or in the recognised herd book of some other country, and of other pigs with four top crosses of registered blood from inspected foundation sows. To record the foundation sows and the sires used in the grading-up process the commission of inspection of the district agricultural society has instituted a district herd book. This book, kept by the local live stock officer, is in manuscript and consists of sheets filed on the loose-leaf system very similar to the Danish private registers. Instead, however, of a separate book for each breeder there is only one book, which is kept at headquarters.

The conditions for entry into the district herd book both of the foundation sow and of the three remaining crosses above her are as follows:—

i. If the animal belongs to a boar society or to a member of such society it must be approved by an expert in pig breeding appointed by the commission of inspection, or if it does not belong to a society, by a representative of the Royal Board of Agriculture.

ii. The animal must have the type distinctive of the breed in question, and must prove to be of good quality with regard to conformation, size and general appearance, health of the animal itself, and health of the herd from which it comes.
iii. If a boar, the animal must be at least 9 months old.
iv. If a sow, it must be at least 12 months old, have been served, and have at least 12 teats.

National Herd Book.—To the National Herd Book are admitted only animals from registered parents or, as explained above, from foundation non-pedigree sows after four top crosses with registered boars. The Swedish Herd Book then is an open one, whereas the Danish one is now closed. It is important, however, to note that in grading up, each generation also comes under inspection and may, if unsuitable, be rejected.

In addition to having the proper pedigree an animal must, to be eligible for entry in the National Herd Book, belong to a herd where all the brood sows are of the same breed and all eligible for entrance in the relative herd book. One further method of control is that all animals, whatever their pedigree, have to be examined and passed by an inspector of the Royal Board of Agriculture before final entry can be made into the National Herd Book It will thus be seen that the Swedish National Herd Book has a good deal of similarity with British ones, and is only to a very slight extent an advanced register, and then only in respect of inspection of conformation.

The information given about each animal in the herd book includes two generations of pedigree, and the only point of interest is that it also includes details of the farrowings of the animal's dam and both grand dams. A typical entry in the case of a Large White Boar is as follows :—

Owners. Trulstorps Boar Society. Mellby, nr. Laholm.

PANTER No. 2215.	B. S. 1694	Bjällösa Alm. 588
		Zuleika XIV. 145
	Svalöv Britt. 1048.	Svalöv Brage. 519
		Svalöv Ella II. 653

	Number of		Average Number of pigs per litter
	Teats	Litters	
Dam.	12	4	13·8
Maternal G. Dam.	12	5	11·6
Paternal G. Dam.	—	11	11·0

Born, 21st July, 1918, at P. Bondesson's Agr. Co., Svalöv.

No further information is given in the book.

Awards for Pig Premises.—For the last ten years the Malmöhus Pig Breeders' Society has been giving annual awards for well-kept pig premises which are judged on the following scale of points:—

[illegible]	Max. points.	
Situ[illegible] ...	5	
Roof	5	
Plan	5	
Walls and doors	5	
Windows and ventilation	5	
Floor and bed...	5	
Troughs and partitions	5	
Cleanliness and tidiness	5	
General impression	10	
	—	50
Exercise Yard.		
Situation in regard to sty	5	
Situation in regard to sun and water supply	5	
Protection against weather and wind ...	5	
Size	5	
Nature of soil	5	
Fences	5	
Management	5	
Method of use	5	
General impression	10	
	—	50
Total		100

First Prize:	80 per cent. of points and over.
Second Prize:	70 to 80 per cent. of points.
Third Prize:	60 to 70 per cent. of points.

Testing Station.—About two years ago a testing station, similar to the three in Denmark, was instituted at Astorp by the Pig Breeders' Society. There are hardly yet sufficient figures from it to give any very useful information, but the results so far reported for 1923 and 1924 indicate that there is a greater variation between the best and the worst strains of one breed than between the average quality of the two breeds kept in the country, and that the quality of bacon obtained from gilts is decidedly superior to bacon from hog pigs.

Offspring Records.—A third, and the most recent test, introduced by the Pig Breeders' Society of Malmöhus, is an attempt to discover the productive capacity of sows by keeping produce records on the farm as distinct from those obtained by sending offspring to a testing station. The practice employed is to weigh the litter of each sow at three weeks and at three months after birth. According to a Swedish report, " it has been

assumed that this capacity might be estimated from the aggregate weight of the sow's litter at the age of three weeks. Up to that age the piglin
od substance for growth on the ...
the dam. In com
respect the aggregate weight, however, should not be the sole deciding factor in estimating the breeding value of any particular sow. The uniformity of the litter with respect to the weight of the various piglings should also be taken into account. By weighing the young pigs, it is, of course, possible to determine at the same time the uniformity of the litter, which is of considerable practical importance."

At the time the writer visited Sweden this type of investigation had only been going on for approximately eighteen months, but even in that short time it was claimed that evidence had been obtained which clearly distinguished the commercial value of different strains. This system is regarded as being one that will yield very good results in the future.

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AGRICULTURAL EDUCATION FOR WOMEN IN BELGIUM.

From a Report submitted by Miss A. E. Wark, Chief Woman Inspector, Board of Education, and Miss E. H. Pratt, Woman Inspector, Ministry of Agriculture, to the Interdepartmental Committee of the Board of Education and the Ministry of Agriculture.

IN October, 1925, the writers paid visits to selected institutions in Belgium in connection with an inquiry into agricultural education for women and girls, with special reference to the provision made for combining instruction in agriculture with domestic science. The position in that country is summarised in the following notes.

Outline of System.—There is under the Belgian Ministry of Agriculture a complete scheme of agricultural education which provides such combined training, from the age of 14 years, for girls and women who intend to engage in rural work. This "house and farm management" (enseignement ménager agricole) is given in three types of institution, representing three stages of instruction. The highest level (degré supérieur) is reached in residential establishments (such as Laeken) of training-college standing, which students enter at the age of

17 and where they may remain for upwards of three years. On the middle level (degré moyen), training is provided in schools, such as Rivierenhof (Deurne) and Quatrecht, roughly comparable, on the agricultural side, to residential trade schools on the industrial side; pupils are admitted at the age of 14 and the course lasts for two years. On the lowest level (degré inférieur) non-residential post-scholastic courses (sections ménagères agricoles primaires) are arranged at elementary schools or other centres for those of school leaving age, and itinerant schools (écoles ambulantes), short courses (cours abrégés) and isolated lectures serve the needs of other girls and women.

In all three grades the training covers farm activities and domestic science, the latter forming an integral part of the course; the work within the house is regarded as of equal importance with that of the farm proper, and instruction in both branches is considered equally requisite. There are at present in England no facilities for such training in house and farm management.*

Historical Sketch.—Agricultural education for women in Belgium seems to have received attention from 1888 onwards. Mention of special provision for women and girls first occurs subsequently to 1890 when the then Director-General, M. Proost, was instrumental in securing grants for six institutions which had organised courses in rural domestic economy. By the outbreak of the War the number of such schools and sections (of the "degré moyen") had increased to 18 and two important convent schools, Wavre-Notre-Dame and Heverlé, were encouraging their normal students to take a fifth year of specialised training in agriculture. Reconstruction work since the War has given a great impetus to Belgian agricultural education as a whole. The provision for women has been notably stimulated, by the organisation in 1919 of a service of itinerant women advisers (conseillères ménagères agricoles), and by the creation, in 1920, of a special institution (Ecole Normale Supérieure d'Economie Ménagère Agricole at Laeken), one of the main objects of which is the training of

* It is to be noted that, apart from this provision by the Ministry of Agriculture, training in domestic science is provided for by two other Departments of State. The Ministry of Science and Arts, which concerns itself with public education, includes domestic subjects as part of the general educational system. The Ministry of Industry, which has charge of public industrial and commercial education, provides technical instruction in domestic science, mainly for city girls and girls at industrial centres. The present inquiry was only concerned with the work of the Ministry of Agriculture.

suitably qualified personnel for the staffing of other institutions. The latest development is the establishment in 1923 of post-scholastic courses (sections ménagères agricoles primaires) for girls of 14 and upwards.

Existing Provision.—The latest available information shows that the amount of provision for the different stages of work is as follows:—

(*a*) On the highest level (degré supérieur) the Institute at Laeken, and a new department (école supérieure) at Berlaer. The convent schools at Wavre-Notre-Dame and Heverlé have a special one-year course, which is supplementary to the two-year course (degré moyen). This higher instruction at Heverlé tends to approximate more and more to the Laeken model.

(*b*) On the middle level (degré moyen) 25 schools and sections, 3 of which are provincial institutions and the remainder convent schools,—all recognised and grant-aided by the Ministry of Agriculture

(*c*) On the lowest level (degré inférieur) 18 itinerant schools (écoles ambulantes) and 34 post-scholastic courses (sections ménagères agricoles primaires). Ten "conseillères ménagères" and their assistants, working under the Ministry of Agriculture, but stationed in the provinces, supervise the itinerant schools, give short courses, lecture to women's institutes and pay advisory visits to farms.

Holiday courses for teachers on all these grades are arranged at suitable centres from time to time.

Departmental Organisation.—The Ministry of Agriculture, now presided over by M. Vandevyvere, comprises 4 main branches (directions générales), one of which deals with agricultural education both for men and women. At the head of this is the Director-General, M. de Vuyst, whose belief in the need for special provision for women created the opportunities referred to above; his zeal and enthusiasm in connection with all stages of this instruction have produced results which have made his work known beyond the boundaries of Belgium. M. de Vuyst is assisted by M. Wauters (Principal Inspector), and has the help of two principal women inspectors (Mme. Haentjens-Deleu in the Flemish provinces and Mlle. Bouillot in the Walloon districts), respectively aided by Mlle. Smeyers and Mme. Marchal-Godefroid. Close personal touch is maintained between the executive officers of the Department and the inspectorate and between the latter and the "conseillères" by meetings and interviews. During absence from headquarters officials are kept up-to-date by systematic circulation of literature and submission of reports on the documents read.

Method of Inquiry.—In the course of investigation of the system outlined above, interviews took place (*a*) with the

Director-General (M. de Vuyst), who explained fully the aims and ideals which had inspired those responsible, and the machinery that had been set up to give effect to their conceptions; (*b*) with a principal and an assistant woman inspector (Mme. Haentjens-Deleu and Mlle. Smeyers), and with a " conseillère ménagère agricole " (Mlle. le Bon); (*c*) with a representative provincial committee, charged with the administration of a school of the " degré moyen " (Deurne); and (*d*) with the heads and staffs of different institutions.

Visits were paid to 3 institutions which were typical of the " degré supérieur " :—

Laeken (State).	
Berlaer (Free).	Convent schools with grants from State.
Wavre-Notre-Dame (Section).	

and to 7 schools or sections of the " degré moyen " :—

Rivierenhof.	(Deurne). Provincial Schools.	All receive grants from State.
Quatrecht.		
Cortemarck.	Convent School under Provincial Control	
Barry-Maulde.	Convent Schools.	
Celles.		
Saffelaere.		
Berlaer.		

Some of these schools, notably Berlaer, Cortemarck and Saffelaere, comprise also post-scholastic courses (sections ménagères agricoles primaires).

A particularly interesting example of the itinerant school (école ambulante) was seen at Furnes, in the form of a caravan school (" école roulotte "), specially constructed for use in villages in the devastated areas. Attendance at a meeting of a women's institute (cercle de fermières), furnished an opportunity for studying a representative country audience, and also for hearing a typical lecture from one of the " conseillères " on fruit preservation.*

On the horticultural side, a visit was paid to Vilvorde, a State Horticultural College to which women are admitted; this visit showed that whilst girls and women have their special organisation (écoles ménagères), they are not precluded from profiting by specialised training at other institutions. The women students attending this school intended to run fruit farms of their own.

* The close connexion of these " cercles de fermières " with the educational system is valuable. It often happens that the former pupils of an " école du degré moyen " or " ambulante " form the nucleus of one of these " cercles " ; in other cases they are founded by the " conseillères."

Degree courses in agriculture at different universities are open to women as to men, but time did not permit of a visit to a University.

The varying agricultural conditions seen during this tour, which included horticultural areas round Ghent, the dairying country of Dixmude, the market gardening and small farms about Malines and Tournai, supplied a very complete background to the inquiry.

Institutions for House and Farm Management Training.—Some idea of the character of " Enseignement ménager agricole " on the highest level (degré supérieur) may be gained from the following account of three institutions visited at Laeken, Wavre-Notre-Dame and Berlaer. The last two require special description because they combine the functions of different types of schools. They are on the same level as Laeken in that they train " régentes ménagères agricoles," but they differ from it in the fact that such training is only one of several activities. Particulars of institutions providing training on the middle level (degré moyen) and on the lowest level (degré inférieur) will be given in a subsequent article.

Laeken.—The Institute of Laeken is a special foundation, established by the State in 1919 with the dual purpose of :—

1. Training teachers for all branches of " enseignement ménager agricole."

2. Preparing " une élite féminine " by means of a high social and technical education capable of raising the standard of country life, and giving to the daughters of proprietors and farmers, sound ideas about rural domestic economy.

Property and Administration.—The estate on which the school stands is a comparatively recent gift from the Crown to the State. The original chateau stands in a park of 37 acres, with woods and tennis lawns and 15 acres of cultivated ground. The chateau is used as a residence and training centre for first-year students. In the development of the scheme two new buildings, for second- and third-year students respectively, were found to be necessary, as well as a house for the Director. A " Colonial Pavilion " (reproducing conditions in the colonies), serves at the same time as a local itinerant school (école ambulante) for farmers' wives and daughters and as a practising ground for students. The Ministry of Agriculture appears to have spent about 1,100,000 francs in adapting the original buildings, building the Director's house and the establishments for the second- and

third-year students, and furnishing the whole installation, equipping the laboratories, and purchasing scientific apparatus.

Belgian students pay tuition fees of 500 francs per annum, others pay 1,000 francs; these payments, together with the Government subsidy, are used for salaries of teachers, rent and upkeep. There is accommodation for from 70 to 80 pupils. Students are resident as this is considered an essential feature of the scheme; in exceptional circumstances a non-resident pupil may be received, but she is then required to be at the Institute from 8 a.m.—6 p.m. The housekeeping side of the institution is run on self-supporting lines, each pupil contributing her quota to the actual cost of food and laundry; no paid domestic labour is employed.

For practical instruction in agriculture the school has at its disposal a farm; market, fruit and pleasure gardens, and demonstration and experimental plots. The farm received an initial endowment of 40,000 francs and has since been run as a commercial proposition.

Staffing.—The Director of the institution is assisted by three house mistresses, each in general charge of the students of a particular year, and each having technical qualifications for teaching the subject in which she has specialised; other mistresses (régentes) are engaged in teaching cookery and other branches of practical work. There are also numerous visiting teachers and professors who are in charge of such subjects as pedagogy, natural science, anatomy, principles of agriculture, elocution, English language, etc. In turn two assistants from the itinerant school (école ambulante) come to take part in the work of the institute, and so rub up their own knowledge of methods and practices. At the conclusion of the course the best students of the third year are kept on as monitresses, free of charge.

Conditions of Admission.—Candidates must be 17 years of age, have reached the standard of a leaving certificate from a Secondary School, and must produce a medical certificate as to fitness for domestic and agricultural work.

Course of Studies.—All intending teachers take a residential course of two years, at the end of which they specialise at Laeken or elsewhere, either in practical agriculture, or in methods of practical teaching.

During the two-year course the subjects studied include (1) all branches of domestic work (cookery and dietetics, laundry work, household management, etc.); (2) agriculture,

with special reference to branches which are of interest to women (dairy-work, poultry-keeping, horticulture); (3) the scientific principles underlying the above, rural law, etc.; and (4) principles of teaching (psychology, pedagogy). Particular attention is paid to the training of students in family life, and with this end in view two "toddlers" are always in residence, under the charge of different students in turn, who act for the time being as the "mother."

Normally the mornings are devoted to practical work, the afternoons to theoretical work and lectures. For practical work, students are divided into five groups (cookery, dairy-work, laundry-work, gardening, household management) which change their work every week during the two years. As no servants are kept, the students have a good deal of additional practice, over and above their classroom work, in the ordinary routine of house, garden and farm.

Examination System.—Tests of progress are held periodically, marks being awarded on the following basis:—

Theoretical knowledge	25 per cent.
Practical work	50 „ „
Individual initiative (of which records are kept during the training and in which special tests are set)	25 „ „

The same proportion is observed in the final examinations held at the end of the course, on the results of which the diploma of "régente ménagère agricole" is granted. This degree is peculiar to Laeken.*

Features of Special Interest.—The dining-rooms are so planned that they serve as dining-room, classroom or recreation room. They are furnished with small polished tables, which seat two individuals for classroom purposes, but can be grouped together for meals, or set aside if the room is used for dancing, etc. The initial cost of these tables is probably higher than that of ordinary dining tables, but the use of the room for a triple purpose is an economy.

Each student has a study-bedroom of a good size (15 ft. by 12 ft.) to herself. Much attention has been given to saving of space and harmonious effect in the furnishing of these rooms; not only are they completely equipped as regards wardrobe and cupboard space, writing-table, bookcase and so on, but

* Diplomas of "régente scientifique" and "régente littéraire" may be obtained in the normal schools, organised under the Ministry of Arts and Science, and are a necessary qualification for those intending to teach in "écoles moyennes."

each has its own colour-scheme, and different rooms have different types of furniture such as are used in an ordinary home, *e.g.*, in one case the wood may be polished, in another stained, and a third painted. It is part of the student's training to look after their rooms—which they change each month; they are asked to criticise and compare the rooms as to beauty and convenience.

In connection with the housecraft instruction, there is a " shop " to which tradesmen bring their goods, which students receive, check, store and sell as required (usually once a week) to other students; careful accounts are kept. Here, too, are stored preserved fruits and vegetables, made by the students.

All the kitchen classrooms are planned and furnished to be as much in keeping as possible with family home-life. The usual unit is one stove, one table and equipment. At Laeken, all the work is arranged for groups of six girls, and each student (since this is a training college) has for the week her own table, her own section of a large kitchen stove, her own cupboard and her own shelf of individual pans. Each student cooks for a given number of persons and works out the cost of the meal. The kitchens are really pretty rooms, and set a standard of what a home-kitchen might be. The brightly coloured check coverings, the glazed and checked sets of provision jars and the orange-coloured marmite pans all combine to produce an attractive and homely effect. There is a large assortment of kitchen appliances and everything is spotlessly clean. The general plan was to use hand appliances throughout the first year, and in the second year to use machinery of various kinds, power-driven or electric. Practice in the use of electricity for heating, lighting and for cooking is necessitated by the increasing installation of electricity throughout the countryside in Belgium.

Students take part in an excellent system of filing of all papers. In the common-room are cabinets, in which are collected any papers or illustrations referring to the subjects of lectures or practical work. These collections, which are additional to personal files, are then available for students' use in private study.

On the agricultural side it was interesting to note that pupils, though being taught to use ordinary equipment, were also introduced to modern machinery and improved methods. Operations were being timed with a view to speeding up action and to eliminating useless movements. Various types of

separators were seen and milk-recording and milk-testing were being carefully carried out. There were ample facilities for horticultural instruction on a suitable scale. The preparation of rations for live stock is a feature of the instruction. Alterations in the farm buildings were in contemplation, and the agricultural work will no doubt be extended and developed.

Distinguishing Characteristics of Laeken.—The question as to how far the Institute at Laeken had succeeded in satisfying the two principal aims for which it exists is not one that can be answered after a brief visit, more especially since the Institute has only been functioning for five years. The dominant factor in the conception of this institution was the belief that the rehabilitation of agriculture, particularly after the war, depended on the regeneration of the rural home. In order to realise this, the Department set themselves to train women who should not only be competent cooks or dairy-workers (or competent instructresses in these branches), but who should also be rural home-makers. For this reason Laeken seeks to reproduce the setting of home-life in the country and to develop those qualities of character (*e.g.*, initiative, common-sense, good taste, etc.) which are essential factors in the harmony of home and social life, in correlation with a training in methodical habits.

The distinguishing marks of Laeken are the combination of training for teaching and for all the duties of rural home life (including both agriculture and household work), and the co-ordination of a systematic practical training with character formation. In these respects it differs fundamentally from anything yet existing in this country. The effects are likely to be far-reaching, since in the first three years there were 44 pupils (*i.e.*, 55 per cent.) in training as teachers, in addition to the daughters of landed proprietors and large farmers who were being fitted to play a useful practical part in rural life.

The system of instruction at Laeken has aroused world-wide interest, and several countries have sent delegates to study it with a view to the creation of similar establishments.

Wavre-Notre-Dame.—This convent school comprises :—

1. A kindergarten of about 20 pupils.
2. An elementary school of about 225 pupils.
3. A secondary school of about 180 pupils.
4. A technical school of about 80 pupils.
5. A " lycée " of about 52 pupils.

6. A Froebel Department with 38 students.
7. A training college for elementary teachers with 242 students.
8. A training college for secondary teachers with 45 students.
9. A training college for teachers of house and farm management with 32 students. (This is under the supervision of the Ministry of Agriculture, to whose requirements the new school, which adjoins the farm, will conform.)

In addition there are some 170 nuns in residence, *i.e.*, a community of about 1,000 persons in all.

The convent, which was largely destroyed during the war, has been rebuilt on a magnificent scale, mainly from reconstruction money, and covers a large acreage. The building reaches a high standard as regards spaciousness, light, ventilation and convenience of planning, especially in regard to installation of labour-saving appliances. The architect (a member of the sisterhood), has succeeded in combining beauty of design with practical utility. The reception rooms, for instance, resemble a winter garden, while the recreation rooms and rooms set apart for private study are planned on a generous scale. There are large and splendidly equipped kitchens for the preparation of meals, and a good bakehouse. Indeed, all the domestic arrangements are thoroughly up-to-date, particularly from the point of view of mechanical services. The cubicles provided for students, 50 in a dormitory, are small but attractively constructed and furnished with all the essentials; bath-rooms are on a lavish scale.

The agricultural school, though incomplete at the moment, is being planned on the same lines. There are good opportunities for practical work in the gardens, the poultry-yard and dairy, and plans are in hand for the improvement of the cowhouse. At the present time, students taking the agricultural course make use of the accommodation and instruction provided at the training college proper, including the domestic science section—which is a feature of the training course, and for which an extremely well furnished kitchen is provided.

At the head of each department is a " Directrice," working, with suitable assistants, under the Mother Superior.

Students in the training college for elementary teachers take a three-years' course (from the age of 16-19 years), which may be preceded by a preparatory course (14-16), including domestic science but no agricultural instruction. Students who wish to specialise in agriculture can at the age of 16 take a two-years' course in " enseignement ménager agricole " followed by six months' practice in teaching, in order to qualify as " régentes

ménagères agricoles." During this two-year course, students give three half-days a week to domestic science, and two half-days a week to practical agriculture; the remainder of their time being devoted to science and subjects allied to agriculture. In the domestic science course they work on the group system previously described.

The domestic science section is a particularly well-equipped and well-organised part of the college; its importance is shown by the fact that every student in the training college receives instruction in domestic science during each year of her college life. Similarly all the boarders learn domestic science when they reach secondary school age; those who so wish may, at the age of 14, study domestic subjects for two years half-time. Extra fees are paid for this and an examination may be taken and a certificate obtained at the end of the course. The mistress in charge of this responsible work completed both her general and domestic training at Wavre-Notre-Dame.

The mistress in charge of the agricultural section, a woman of interesting personality, not only teaches agricultural subjects but gives instruction in sewing, cutting out, science, hygiene and geography to students in the training college.

The fact that an institution of this size and importance gives such a prominent place in its curriculum to teaching of agriculture and domestic subjects, while still maintaining high standards in the more ordinary branches, must have a far-reaching influence, both on professional and on home life throughout the country. It is very active in the organisation of summer and vacation courses under visiting professors from the University of Louvain.

Berlaer.—This convent school (the property of the Order of Saint Coeur de Marie) had formerly a special technical or trade school under the Ministry of Industry; this has been discontinued and only survives in the form of a "lace-making" class. The convent is now concentrating on "enseignement ménager agricole" and possesses both an "école ménagère agricole du degré supérieur" (for the training of teachers in farm and household management) and an "école ménagère agricole du degré moyen." There is also attached to the school a "section ménagère agricole primaire," which is attended by girls from the village. It conforms to the requirements of the Ministry of Agriculture with regard to these post-scholastic courses, and also serves as a practising ground for teaching for the students of the "école ménagère agricole du degré

supérieur." Every phase of house and farm management (enseignment ménager agricole) may, therefore, be studied at Berlaer.

An outstanding feature is the model farmhouse and buildings, which were specially designed by M. de Vuyst to afford a practical example of desirable conditions under which farm work could be carried on, and also to supply a suitable and convenient practising ground for the students' own operations. The farm kitchen is very attractive, well planned, and well equipped, with several windows, two of which permit oversight of some of the farm activities. Opening out of the kitchen are a dairy and scullery, and off the latter is the store room, larder and cheese room. Opposite the kitchen is the farm living-room. The centre of the farm buildings is a room or shed which is set apart for the preparation of the animals' rations; it is directly connected with the barns, stable, cow-sheds, etc., and has in addition one large entrance, which allows of the passage of a loaded cart. It also communicates by a double door with the kitchen. The comfort and convenience of the farmer's womenfolk have been specially studied in this arrangement which allows them to carry on many of their most important agricultural duties under cover. The possession of this model farm is a great advantage, since excellent practical experience is provided for pupils taking the courses in question. They reside at the farm and undertake daily the routine work which falls to the lot of farm women.

The nature of the "école ménagère agricole du degré supérieur" of Berlaer may be indicated by reference to the curriculum at Laeken, with which there are many points of general resemblance. Berlaer, however, concentrates on the training of the prospective teacher in the elementary school and provides her with a sound knowledge of "enseignement ménager agricole." The character of the instruction given in the "école ménagère agricole du degré moyen" may most conveniently be considered in connection with the other schools of that grade, which will be dealt with in the second article.

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THE CONTROL OF APHIDES INFESTING BULBS IN STORE.

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To many of those who handle bulbs purely as gardeners, it may be news that dry bulbs frequently carry heavy infestations of aphides. This fact is, however, by no means novel to those whose business in bulbs compels them to store considerable quantities in a dry condition in the seasons between lifting and planting. To such, these aphides constitute a troublesome pest, occasioning serious consequences and not infrequently involving the destruction of valuable exported consignments at the port of entry.

The insect responsible is known by the name of *Anuraphis tulipæ*, Boyer de Fonsc, although a second species (*Rhopalosiphoninus tulipælla*, Theob.) has also been recorded. The life histories of these species are still somewhat obscure. It is not unlikely that they have an alternate host in some other kind of plant during a portion of the year. In the Report of the State Entomologist in the New York State Museum Bulletin (No. 134, 1908) mention is made of attacks by *Anuraphis tulipæ* (under the name of *Aphis gladioli*) on gladiolus corms. During the investigation made it was found that, by the middle of August, all aphides had disappeared from the storage warehouse and from the plants in the field. The Bulletin goes on to say that "It is stated that when digging in October a few plant lice may be found upon the bulbs." Winged forms appear from time to time amongst the populations infesting bulbs in store, such appearances seeming to take place over a period of several months.

Little is heard of *A. tulipæ* upon growing plants in the open. It might, in fact, almost be described as a stored products pest as far as its recorded depredations are concerned. Infestations probably start with a comparatively few individuals on bulbs brought into the store; the increase is then rapid, and as the planting season advances a large number of bulbs may be in a bad state—tulips, gladioli, bulbous irises, and such rhizomatous species as are stored in the manner of bulbs, being the chief subjects attacked. The aphides live in large colonies under the outer skin of the bulbs or corms, the "flesh" becoming pitted, soft and discoloured. Later, when the shoot begins to show in the case of bulbs, the whole interior between the scales

may become badly infested through the opening of the apex permitting the pest to enter.

Experiments have been made, and are at the present time in progress, at the Ministry's Plant Pathological Laboratory, Harpenden, to discover a means of controlling these bulb aphides, the whole matter having been brought to a head through the destruction by colonial authorities of a valuable consignment of bulbs and rhizomes exported from this country because they were infested with aphides and mites. Since the consignment appeared perfectly clean on despatch it is assumed that a large population had developed during transit from a few well hidden and undetected insects. Indeed, it was ascertained by the dissection and microscopic examination of a duplicate consignment that the insects could only have been found, before packing, by methods that involved the destruction of the bulbs.

The experiments referred to are still quite in their initial stages, but a control, giving promise of satisfactory results in commercial practice, having been arrived at, it is felt that bulb growers might care to give the method a trial in a tentative way while there is yet time to plant this season, and so place themselves in possession of definite information as to its usefulness and possibilities before next season's bulbs are received in store.

No illusions were entertained at the outset as to the difficulties to be overcome in combating these aphides, which are well protected in the interior of the bulbs; but, after trials of various methods and substances, which need not now be dwelt upon, a control was arrived at by the very simple process of exposing bulbs to the vapour of paradichlorbenzene, a crystalline substance which possesses the advantage of being clean and safe to handle and relatively inexpensive.

The full effect of the treatment upon the bulb itself has not yet been ascertained. None of the treated bulbs have been quite dormant, the greater proportion showing a shoot of greater or lesser length: the test upon the bulbs has therefore been a severe one. With one exception no damage to the bulb or its spike has been observable, and bulbs planted after treatment appear, as far as can be ascertained at such an early date, to have rooted well and to be developing their growth in normal fashion.

The exception refers to Iris filifolia and Iris Giant Xiphium. Bulbs of these, for the most part in poor condition through their planting season being so far over-run, were exposed to treatment

for 96 hours. The shoots of these bulbs were very long, they were in actual contact with the paradichlorbenzene, and on removal they were found to be burnt. Cottage tulips, however, under the same conditions for 96 hours, showed no damage to the spikes, which were of fair development. All these bulbs were severely attacked by aphides before treatment.

Method of Treatment.—The method which has, so far, given best results with dry crystals of paradichlorbenzene is to place a layer of them on the bottom of a box used as a fumigation chamber, to cover these crystals with a single thickness of sacking of somewhat loose texture, place a single layer of bulbs upon this, and to cover down with another piece of sacking, finally placing upon this a second layer of crystals. The bulbs are then shut down for not less than 48 hours, preferably for three days.

The advantage of 72 hours' treatment over 48 arises from the circumstance that all aphides in the process of skin changing will have passed through their moult and become fully subject to the treatment. It was observed that after 48 hours' treatment an occasional bulb, badly infested to the core, would on dissection reveal an aphid showing signs of life. It is believed that this insect was about to change its skin when the bulbs were placed under treatment and so received a special protection during the first 24 to 48 hours through the outer skin not having been discarded. It is possible that the time of exposure could be reduced if treatment was resorted to at an early date after the lifting of the bulbs. The insects then present would probably be confined to areas of the bulb immediately under the outer jacket.

It is essential that the container should be as air-tight as possible, and as full as possible, leaving very little empty space. Further, if the bulbs are placed in successive layers, they should be so arranged that there is a layer of paradichlorbenzene and a layer of bulbs alternately, each layer of bulbs being thus sandwiched between two layers of paradichlorbenzene.

For the experiments, pure paradichlorbenzene has been used. The cheaper grade, however, known as "technical," is equally fatal to the pests, but it remains to be seen whether the bulb is more likely to suffer with this less pure form of the chemical. The quantity of paradichlorbenzene found effective has been 4 oz. to the square foot, placed between fairly loose sacking; this amount is for a single layer of bulbs. With bulbs placed in successive layers, it applies only to the bottom layer,

which has 2 oz. per square foot of paradichlorbenzene above and below it. The amount for each succeeding layer would work out at 2 oz. per square foot only. Bulbs vary so much in size that it is difficult to estimate cost to a close figure. In a single layer, eighty May-flowering tulips covered a square foot, but is not yet possible to estimate on this basis, as the amounts used to the square foot would be sufficient, if kept in an air-tight container, to treat several lots of bulbs. The loss in weight of paradichlorbenzene when used in this way is under investigation.

Paradichlorbenzene is readily soluble in carbon tetrachloride, which is non-inflammable. It has been found in the course of the experiments that results superior to those obtained from loose crystals appear to accrue from dipping cloth or blanket in a solution of paradichlorbenzene in carbon tetrachloride and allowing the latter to evaporate, which it does in a few minutes. When dry the cloth is used between layers of bulbs instead of the loose crystals between sacking. In these trials 100 per cent. control was obtained with both aphides and mites in 48 hours, the proportion of paradichlorbenzene used to the square foot being very much less. Further work upon these lines is being undertaken, while the possibilities of using cheaper substances such as naphthalene are also being investigated.

To prepare an impregnated cloth, 1½ oz. paradichlorbenzene may be dissolved in 6 oz. of carbon tetrachloride, the cloth being dipped in the solution until thoroughly soaked, afterwards being hung in the open air until the carbon tetrachloride has evaporated, leaving the cloth dry. Cloths vary much as to the amount of liquid they will absorb. As a rough guide it may be mentioned that an ordinary glass-cloth covering 4 square feet will take about two-thirds of a solution made in the foregoing proportions.

Mites.—Reference to the November (1925) issue of this *Journal* will show that Bulb Mites are hardly to be regarded as a primary pest. Experiments are in progress to test the validity of this contention, but the presence of mites upon bulbs exported is still objected to by the authorities in foreign countries, so that a controversial point would possibly be solved if a means of destroying the mite could be found. It is worthy of mention, therefore, that the paradichlorbenzene treatment outlined above has also proved effective against mites. The latter, however. when on bulbs are reproduced viviparously, so

that the question of eggs does not arise, but the case with mites is different and the effect of treatment upon the eggs of mites is under observation. Incidentally, it was found in operating against mites in bulbs much decayed, that larvae of flies feeding upon the decayed matter were destroyed, so that it is possible Narcissus fly larvae might also succumb.

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FEBRUARY ON THE FARM.

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Agricultural Organiser for Derbyshire.

Land and Crops.—Tradition favours a wet, even a snowy, February. The well known couplet regarding this month really expresses a pious wish that February may fill the ditch; for the saying continues " Black or white, don't care which: if it be white it's the better to like." There is a common if not very well founded belief that a long spell of fine dry weather in this month must ordinarily be counterbalanced by wet, hindering conditions in March or April, when farmers are anxious to proceed with working and sowing the land.

If conditions permit, sowings may be made of winter oats, hardy spring oats, such as Goldfinder (yellow) and Bountiful (black), spring wheat, beans, vetches, peas and barley. During recent years a number of new varieties of barley have been placed on the market, some of which are described in the Ministry's leaflet No. 391 (Barley Growing). Of the narrow-eared kinds, Spratt-Archer has done well in field trials, yielding well and producing grain of higher malting quality than either of its parents. Plumage-Archer is a good broad-eared sort. Varieties of oats are discussed in leaflet No. 353 (Oats), which is of special interest at this time.

Towards the end of the month seed beds of marrow-stem kale, kohl-rabi and ox-cabbage may be prepared and sown to provide plants for setting out in the field in April or May. This practice allows of the land being cleaned and properly prepared before planting, without reducing the yield of the crops by late sowing. Kohl-rabi in particular benefits from early establishment, and marrow-stem kale may also be put in early without fear of running to seed. The first breadth of early

potatoes is occasionally planted in February; this crop requires more liberal treatment than second early or late varieties.

The "seeds" break does not ordinarily call for attention in this month, except chain harrowing and stone picking where yard manure has been recently applied. Top dressings of quick acting nitrogenous fertilisers may be applied where early growth is specially desired, as may be the case where the supply of roots is likely to run short. In the neighbourhood of Edinburgh a special feature is made of forcing grass seeds mixtures for the production of early green food, which is required by the city cow-keepers. Nitrates are applied in February and again in March in order to produce a growth sufficient to cut in April.

Root and Fallow Land.—Fields intended to be bare-fallowed —a practice still sometimes necessary for the thorough cleaning of weedy, heavy land—need not be ploughed or cross ploughed until March or April. Earlier stirring tends to produce a tilth, whereas the best results in bare fallowing are obtained when the soil is caused to form large clods, which will dry and bake through, killing the weeds. For root crops, however, cross ploughing when the soil is in fit condition is most advantageous. As a result of this operation the soil is earlier ready for further working and breaks down to a better tilth. Operations such as cross ploughing and early ridging up promote drying, which has been shown to stimulate productivity in a manner resembling partial sterilisation. If yard manure intended for roots is available, and can be applied and ploughed under during this month, it need not be kept back for application in the ridges.

It is interesting to observe how, during the past few years, the opinion of the practice of root-growing has matured to the point of recognising that roots and fallow crops are the pivotal crops in the rotation, and the foundation of good arable cultivation. "Secure these, and cereal crops automatically follow." It was the introduction of roots that lifted British farming out of the rut of low productivity that prevailed until the middle of the 18th century. As it was during the ascendancy of agriculture in this country, so it has been in more recent times in Denmark and Germany:—development has proceeded in close association with the extension of the acreage under crops of the roots class. When land is farmed well enough to grow good crops of roots, it will produce seeds and cereals in abundance.

Hedges.—Grassland cannot be properly grazed unless the stock are confined to suitable areas. During February and March repairing of gaps and the "laying" or "pleaching" of tall hedges are important operations on pastoral farms. Hedges laid in these months are expected to make rather better growth of young shoots than those laid in autumn. The result, however, depends on the method of laying and particularly on the thickness of wood and bark left in the "tongue"—the part bent over. The growth of young shoots from the "heel" or stump is induced by cutting nearly through the sap-wood, so that the upward current of sap from the roots to the old brush is restricted. If at the same time sufficient bark is left (bark carries the downward current) food materials elaborated by the leaves will continue to feed the roots. This practice, however, involves risk of the death of the pleach before the young growth is sufficient to form an effective barrier; also, unless the tongue is reasonably thick, the pleach may readily break off when touched by cattle.

Replanting of gaps in hedges is very rarely attempted, with the result that many fences now contain too large a proportion of post and rail, not to mention barbed wire. February is not too late for the planting of strong young quicks; but where replanting was intended the site should have been prepared in advance. The old soil has to be removed to a depth of 15 inches, all old roots cut off and dug out, fresh soil put down, and manure applied. Without these precautions hawthorn will not grow again in the same place, although certain other hedgerow plants may. Thorn hedges grow badly on soils short of lime, and the gaps are often due partly to this defect of the soil. It may be futile to replant without the addition of lime to the site.

Dairy Farming.—For many years the chief tendency in British agriculture has been towards the production of milk for sale. Counties such as Norfolk, Suffolk, Essex, Sussex and Hampshire with large areas of arable land have become important sources of the London milk supply; and in some of the older dairying districts, such as Derbyshire, milk selling since about 1870 has almost completely superseded home cheese making. The principal farm product in England to-day is milk. The extension of dairy farming, however, continues, and, even in many counties which already contained relatively large numbers of dairy cows, considerable increase in milk-

producing stock has taken place since 1912. The following particulars show the counties in which dairy farming has made the greatest expansion in recent years:—

INCREASE IN THE NUMBER OF COWS AND HEIFERS ON 4TH JUNE BETWEEN 1912 AND 1924.

County.	In milk.	Dry, in-calf.	Total increase.
East Sussex	17,049	7,309	24,358
Salop	14,421	5,595	20,016
Gloucestershire ...	10,334	7,462	17,796
Somerset	10,653	6,430	17,083
Staffordshire ...	9,495	7,260	16,755
Wiltshire	9,868	5,995	15,863

Not only are the numbers of milch cattle increasing, but, on the evidence of the annual reports of milk recording societies, the average yield per cow is rising. The output of milk per cow and per acre has improved in recent years to an extent that probably has no parallel in beef production, crop production or any other branch of farming except perhaps poultry keeping. Moreover, by the wider adoption or more intensive application of grassland improvement, root growing, rationing, frequent watering, recording, and the use of dairy bred bulls, the output of milk could be still further increased, provided that there were a satisfactory demand for the additional produce.

Winter Milk Production.—During the past few years the problem of marketing milk has presented much difficulty. During the winter months supplies have exceeded the demand for liquid milk; and the products into which surplus milk can be converted—butter, cheese, etc.—are not sufficiently valuable to realise a price within about 4d. per gallon, for the milk so utilised, of that which farmers consider necessary in winter production. At the time of writing milk is obtainable at prices lower than those payable under current contracts; smaller retailers have requested certain suppliers to reduce their consignments and large buyers are converting large quantities of milk into cheese, etc. One milk retailing organisation in Derby, for instance, is making cheese of 400 to 500 gallons per day supplied by farmers in excess of their October deliveries. This is the third successive year during which the dairy in question has been making cheese in mid-winter, and the cause is the increase in the proportion of autumn- and winter-calving cows; for which the autumn contract and the relatively high contract prices for winter milk are mainly responsible.

NOTES ON MANURES FOR FEBRUARY.

SIR JOHN RUSSELL, D.Sc., F.R.S.,
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Quality of Slag and Productiveness.—A question often asked at farmers' lectures is whether quality of slag makes very much difference to its agricultural value, and, as a concrete example, whether 5 cwt. of a low-grade slag per acre would not prove just as useful as 5 cwt. of a high-grade slag provided both were equally finely ground. Much interest has been taken from time to time in this problem not only at home but in the Empire, and inquiries relating to it have reached the writer from farmers as far away as New Zealand. In view of this widespread interest, the Ministry's Basic Slag Committee arranged for an experiment in 1923, at Hebron Farm, Northumberland, to be carried out under the supervision of Professor Gilchrist, in which 5 cwt. per acre of a high-grade (42 per cent.) slag were tested against 5 cwt. per acre of a low-grade (22 per cent.) slag, of a low solubility, on grazing plots similar to those at Cockle Park. Each plot was 2½ acres in extent. The unmanured plot carried five sheep throughout each season, the plot receiving low-grade slag carried seven the first season, nine in the second and ten in the third. The live weight increases in lb. per acre were :—

Treatment	Live weight increase (lb.) of sheep per acre			
	1923	1924	1925	Average
1. 5 cwt. basic slag ... (22 per cent.), Nov., 1922.	68.4	92.4	71.6	77.46
2. Untreated	40.4	64.4	52.8	52.53
3. 5 cwt. basic slag ... (42 per cent.), Nov., 1922.	48.0	134.8	122.8	101.86

Still further evidence was obtained on the hay plots on West Tower Hill Field, Cockle Park, where the effect of 10 cwt. per acre of the high-grade slag was compared with that of an equal weight of low-grade slag; while other plots were set up receiving respectively 5 cwt. per acre of the slags. The results have been :—

Treatment per Acre	Yield of Hay, cwt. per acre			
	1923	1924	1925	Mean
Control. No slag. ...	14.9	12.5	14.9	14.1
High-grade, 10 cwt. ...	26.8	26.6	30.9	28.1
Low-grade, 10 cwt. ...	20.8	16.4	18.9	18.7
High-grade, 5 cwt. ...	22.0	19.2	22.1	21.1
Low-grade, 5 cwt. ...	19.6	15.2	17.1	17.3
High-grade, 5 cwt. ... Ground lime, 10 cwt.	23.7	24.0	29.1	25.6

This table brings out the interesting result that 10 cwt. per acre of the low-grade slag is but little better than 5 cwt. and is considerably less effective than 5 cwt. per acre of high-grade slag. If this result turns out to be true, it would seem to follow that a farmer will not be able to make up for low quality by simply increasing the quantity of slag he applies; at Cockle Park and on similar land in the north it is the high soluble material that counts. 10 cwt. per acre of high-quality slag proved better than 5 cwt. per acre, giving exactly double the increase in yield; in the three years the 10 cwt. of slag gave an extra 42 cwt. of hay over the unmanured yield, against the additional 21 cwt. yielded when only 5 cwt. of slag was applied per acre. Ground lime, added at the rate of 10 cwt. per acre to the 5 cwt. basic slag, also increased the yield over the three years by 13.5 cwt. per acre; not as much as was given by the extra slag. The low-grade slags (*i.e.*, slags of low phosphate content and low solubility) present a difficult problem which is not yet solved. From experiments carried out at Rothamsted it does not appear that further fineness in grinding will increase their value.

Slagging of Pasture and Soil Moisture.—One of the most striking demonstrations at Cockle Park is the effect of slag in deepening the root range of the herbage and so opening up the soil to the absorption of water. The land without slag, whether unmanured or stocked with sheep to which cake has been fed, is only with difficulty pervious to water; it is hard and dry below the surface, and the rain, especially when it comes after a drought, is unable to soak in but lies in the furrows, encouraging rushes and other undesirable vegetation. On the slagged plot, a deeper-rooted herbage has been developed, opening up the subsoil and allowing water to soak away easily; there is no development of rushes in the furrows while the purely surface grasses, such as bent, are crowded out.

Manuring of Malting Barley.—Considerable interest has been aroused over the results of the experiments carried out by Rothamsted workers under the Institute of Brewing Research Scheme. It is shown at a number of centres that an additional 5 bushels of barley per acre were obtained without detriment to the valuation by giving 1 cwt. sulphate of ammonia per acre. At the Norfolk centre—Newton St. Faith—it is shown that a further additional crop is obtained by the use of superphosphate and potassic fertilisers. The figures are discussed in a Report issued by the Committee of the Norfolk

Agricultural Station where it appears that the valuation of the barley was actually increased by using the nitrogenous manure, while the financial results were satisfactory. It remains to be seen, however, how the sulphate of ammonia will affect the clover seeds sown in the barley. There are numerous instances where a heavy barley crop has caused a diminution in the following clover crop which, in turn, has brought about a reduction in the following oat or wheat crop. In the Backhouse Field rotation experiments at Cockle Park the net gains per acre are decreased by feeding half the roots on the land to sheep which also receive hay or hay and 10 cwt. of cake per acre. The barley crop gained especially in bulk of straw, but it became somewhat laid, thereby losing in quality, besides checking the young grass and clover seeds. The hay crop therefore suffered, as also did the succeeding oat crop. It should not prove impossible to overcome this difficulty, and experiments will no doubt be started to find a way round.

Green Manuring.—In the past season's experiments, the undersowing of winter corn crops by green manure crops in spring has not proved successful in the eastern counties owing to the serious drought in May and June. Of the crops tested, ryegrass and trefoil mixtures suffered least, and there is some ground for thinking that better results would have been obtained had the sowing been earlier. Possibly this might cause a certain bulk of green stuff to be cut with the corn, but the disadvantage is less for wheat and oats than for barley. Bokhara clover at first appeared promising but it failed to stand the winter. Methods of green manuring are being tested out by the Rothamsted workers under the ægis of the Royal Agricultural Society's Research Committee, and experiments are being made in the dry eastern counties by this method of undersowing and in the wetter western counties by catch cropping.

* * * * * *

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	*Average Price per ton during week ending Jan. 6th.*				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	13. 2	...	13.0	...	...
" " Lime (N. 13 per cent.)	...	12.10	...	12. 0‡	18. 6
Sulphate of Ammonia, neutral (N. 21.1 per cent.)	12.15*	12.15*	12.15*	12.15*	(N)12.1
Kainit (Pot. 20 per cent.)	3.10	3. 0	...		...
" (Pot. 14 per cent.)	3. 0	2.15	2.15	2.16	4. 0
Potash Salts (Pot. 30 per cent.)	4.15	..	...	4.10	3. 0
" " (Pot. 20 per cent.)	...	...	..	3. 3	3. 2
Muriate of Potash (Pot. 50-53½ per cent.) ...	9. 2	8. 2	8. 7	9. 7	3. 6
Sulphate of Potash (Pot. 48-51¼ per cent.) ...	11. 0	11. 5	10.10	11. 5	4. 5
Basic Slag (T.P. 34 per cent.)	...	...	3. 4§	...	...
" " (T.P. 30 per cent.)	...	...	..	..	...
" " (T.P. 28 per cent.)	...	2. 8§	...	2.10§	1. 9
" " (T.P. 26 per cent.)	...	2. 3§	...	2. 5§	1. 9
" " (T.P. 24 per cent.)	2. 9§	1.19§	1.18§		...
Superphosphate (S.P. 35 per cent.)	3. 9	...	3.14	3. 6	1.11
" (S.P. 32 per cent.)	...	...	3.11	...	...
" (S.P. 30 per cent.)	3. 2	2.17	3. 7	3. 0	2. 0
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	8.15	8. 0	8. 5	...	...
Steamed Bone Flour (N.¾, T.P. 60-65 per cent.)	6. 2†	6.10†	6. 5	5.12	...
Fish Guano (N. 6½, T.P. 10 per cent.) ...	...	...	...	9.15	...
Burnt Lump Lime	1. 8	1.12	1.18	2. 1‖	.
Ground Lime	1.15	...	2. 8	1.15‖	...
Ground Limestone	1. 7	...	1. 4	..	.

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ Delivered in 4-ton lots in the Home counties.

§ Prices include cost of carriage from works to town named. Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire and London prices are for not less than 4-ton lots delivered within a limited area. Cost to purchasers in other districts will be greater or less according to the distance of different purchasers from the works.

‖ Delivered in 4-ton lots to London.

* * * * * *

MONTHLY NOTES ON FEEDING STUFFS.

E. T. HALNAN, M.A.,

Animal Nutrition Institute, Cambridge University.

Protein-Rich Foods.—Scientific feeding practice advocates the use of rations having a nutritive ratio of 1 : 3.5 to 1 : 6 according to the purpose for which the ration is intended, and insistence from the point of view of economy is always stressed on the need for adding more protein, or carbohydrate as the case may be, in order to obtain the desired nutritive ratio. If we consider the foods normally produced on the farm, it will

be found that, except as regards the legumes, the foods are always deficient in protein. Thus the nutritive ratios of barley, wheat and oats are 1 : 10, 1 : 7, and 1 : 7 respectively. Roots vary from 1 : 7 in the case of the swede to 1 : 25 in the case of sugar beet. Beans and peas, on the other hand, are 1 : 2 and 1 : 3 respectively. Hay ranges from 1 : 2 to 1 : 11 according to origin and quality, and pasture grasses vary from 1 : 4 to 1 : 11, the latter being Timothy grass.

Animals fed, according to scientific practice, entirely on home produced foods would experience a deficiency of protein, except during the spring months when pasture grass was plentiful, or unless special provision was made for the summer and winter months by growing beans and leguminous fodders such as vetches and clover. This insufficiency, or protein hunger, is made up by feeding oilcakes, and other feeding stuffs that are rich in protein, and under normal conditions large quantities of linseed cake, cotton cake, and ground nut cake are purchased for this reason.

Nature and Composition of Proteins.—Research work on the nature and composition of proteins emphasised the fact that proteins vary considerably in their power of replacing the protein lost from the animal's body, and experiments were carried out which showed the necessity for considering the "quality" as well as the "quantity" of the protein fed. The results also showed that proteins of vegetable origin are not so effective in supplying waste of body tissue as are proteins of animal origin. As soon as this was realised commercially, products were put on the market which were generally bye-products of animal origin, and which were formerly sold only for manurial purposes. With the change of use, changes of manufacture were adopted in order that the product sold might be pure and clean, and regarded in every way as a food product. As the result of this, feeding stuffs such as blood meal, meat meal, meat and bone meal, and fish meal were introduced on the market, and command a ready sale at prices remunerative to the manufacturers. In addition to this, a comparatively new feeding stuff, whale meal, is finding its way on the market, either as a straight product, or as a proprietary food. Fresh whale meat, or the meal made from fresh whale meat, is a wholesome food, fresh whale meat being used as a human food by natives of those countries where a supply is readily accessible. There is no reason to doubt, therefore, that whale

Description.	Price per Qr. s. d.	lb.	Price per Ton. £ s	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	§ Starch Equiv. per 100 lb.	Price per Unit Starch Equiv. s.	Price per lb. Starch Equiv. d.	§ Protein Equiv. %
Wheat, British	—	—	12 5	0 15	11 10	72	3/2	1·70	9·6
Barley, British Feeding	—	—	8 15	0 11	8 4	71	2/4	1·25	6·2
„ Canadian :—									
No. 4 Western	31/3	400	8 15	0 11	8 4	71	2/4	1·25	6·2
„ Feed	29/3	„	8 3†	0 11	7 12	71	2/2	1·16	6·2
„ American	30/9	„	8 12	0 11	8 1	71	2/3	1·20	6·2
„ Russian	30/3	„	8 10	0 11	7 19	71	2/3	1·20	6.2
Oats, English, White	—	—	10 3	0 13	9 10	60	3/2	1·70	7·6
„ „ Black and Grey	—	—	9 15	0 13	9 2	60	3/0	1·61	7·6
„ Scotch, White	—	—	10 7	0 13	9 14	60	3/3	1·74	7·6
„ Canadian :—									
No. 2 Western	30/9	320	10 15	0 13	10 2	60	3/4	1·78	7·6
No. 3 „	28/9	„	10 2	0 13	9 9	60	3/2	1·70	7·6
Feed „	26/3	„	9 3	0 13	8 10	60	2/10	1·52	7·6
„ American	26/0	„	9 2	0 13	8 9	60	2/10	1·52	7·6
„ Argentine	25/3	„	8 17	0 13	8 4	60	2/9	1·47	7·6
Maize, Argentine	37/3	480	8 13	0 12	8 1	81	2/0	1·07	6·8
„ South African	37/0	„	8 13	0 12	8 1	81	2/0	1·07	6·8
Beans, English Winter	—	—	10 5	1 10	8 15	66	2/8	1·43	20·0
„ Chinese	—	—	11 7*	1 10	9 17	66	3/0	1·61	20·0
Peas, English Dun	—	—	11 0	1 6	9 14	69	2/10	1·52	18·0
„ „ Maple	—	—	11 13	1 6	10 7	69	3/0	1·61	18·0
„ Japanese	—	—	33 10*	1 6	32 4	69	9/4	4·02	18·0
Dari, Egyptian	—	—	12 10	0 14	11 16	74	3/2	1·70	7·2
Millers' Offals :—									
Bran, British	—	—	7 5	1 5	6 0	42	2/10	1·52	10·0
„ Broad	—	—	9 0	1 5	7 15	42	3/8	1·96	10·0
Middlings—									
Fine Imported	—	—	8 7	1 0	7 7	69	2/2	1·16	12·0
Coarse, British	—	—	7 10	1 0	6 10	58	2/3	1·20	11·0
Pollards, Imported	—	—	6 12	1 5	5 7	60	1/9	0·94	11·0
Meal, Barley	—	—	10 2	0 11	9 11	71	2/8	1·48	6·2
„ Maize	—	—	10 0	0 12	9 8	81	2/4	1·25	6·8
„ „ South African	—	—	8 10	0 12	7 18	81	1/11	1·03	6·8
„ „ Germ	—	—	8 10	0 18	7 12	85	1/9	0·94	10·0
„ „ Gluten Feed	—	—	9 15	1 5	8 10	76	2/3	1·20	19·0
„ Locust Bean	—	—	9 12	0 9	9 3	71	2/7	1·38	3·6
„ Bean	—	—	12 5	1 10	10 15	66	3/3	1·74	20·0
„ Fish	—	—	20 0	3 19	16 1	53	6/1	3·26	48·0
Linseed Cake, English 12°/₀ Oil	—	—	13 7	1 15	11 12	74	3/2	1·70	25·0
„ „ 10°/₀ Oil	—	—	12 17	1 15	11 2	74	3/0	1·61	25·0
„ „ 9°/₀ Oil	—	—	12 12	1 15	10 17	74	2/11	1·56	25·0
Soya Bean „ 6 % Oil	—	—	11 15	2 10	9 5	69	2/8	1·43	36·0
Cottonseed Cake, English 5¼°/₀ Oil	—	—	6 17	1 12	5 5	42	2/6	1·34	17·0
„ „ Egyptian 5¼°/₀ Oil	—	—	6 7	1 12	4 15	42	2/3	1·20	17·0
Decorticated Cottonseed Cake, 8 % Oil	—	—	12 0	2 10	9 10	71	2/8	1·43	35·0
Decorticated Cotton-seed Meal 7°/₀ Oil	—	—	11 0	2 10	8 10	74	2/4	1·25	35·0
Coconut Cake 6°/₀ Oil	—	—	9 5	1 9	7 16	79	2/0	1·07	16·0
Palm Kernel Cake 6°/₀ Oil	—	—	7 17	1 1	6 16	75	1/10	0·98	17·0
„ „ „ Meal 6°/₀ Oil	—	—	8 10‖	1 1	7 9	75	2/0	1·07	17·0
„ „ Meal 2°/₀ Oil	—	—	6 17‖	1 2	5 15	71	1/7	0·85	17·0
Feeding Treacle	—	—	7 2	0 9	6 13	51	2/7	1·38	2·7
Brewers' Grains :—									
Dried Ale	—	—	8 2	1 2	7 0	49	2/10	1·52	13·0
„ Porter	—	—	7 12	1 2	6 10	49	2/8	1·43	13·0
Wet Ale	—	—	1 5	0 8	0 17	15	1/2	0·62	4·8
„ Porter	—	—	0 18	0 8	0 10	15	–/8	0·36	4·8
Malt Culms	—	—	8 0*	1 12	6 8	43	3/0	1·61	16·0

* At Liverpool. † At Bristol. ‖ At Hull.

§ The figures in these columns have been corrected in accordance with the tables given in the Report of the Committee on the Rationing of Dairy Cows.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of December and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 1s. per ton. The food value per ton is therefore £8 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 5d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·29d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices :—N, 11s. 10d.; P_2O_5 [illegible]s. 5d.; K_2O, 2s. 11d.

meal is a suitable product for live stock, provided it is derived from a pure untainted source, but a word of caution is needed. Whaling stations have always been regarded as objectionable because, after removing the blubber, the carcasses were either re-consigned to the sea, or allowed to rot or remain until an opportunity arose for working them up into a guano. There is, however, one Company at least which has realised that in whale meat there is a valuable protein food, and special steps have been taken to produce a meal that is wholesome and pure, and care is also taken that such meal shall be produced from the fresh meat only. It will be very necessary, therefore, for stock feeders and others to be extremely cautious in purchasing any whale meat products unless they can be assured that the produce is wholesome and in every way fit for food. This advice applies equally to all products of animal origin.

* * * * * *

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follows:—

	Starch Equivalent.	Protein Equivalent.	Per Ton. £ s.
Barley (Imported)	71	6.2	8 10
Maize	81	6.8	8 13
Decorticated Ground Nut Cake ...	73	41.0	12 10
" " Cotton Cake ...	71	34.0	12 0

Add 10s. per ton, in each case, for carriage. The cost per unit starch equivalent works out at 2.16 shillings, and per unit protein equivalent, 2.65 shillings.

FARM VALUES.

CROPS.	Starch Equivalent.	Protein Equivalent.	Food Value per Ton, on Farm.
	Per cent.	Per cent.	£ s.
Wheat	72	9·6	9 1
Oats	60	7·6	7 9
Barley	71	6·2	8 9
Potatoes	18	0·6	2 0
Swedes	7	0·7	0 17
Mangolds	7	0·4	0 16
Beans	66	20	9 15
Good Meadow Hay	31	4·6	3 19
Good Oat Straw	17	0·9	1 19
Good Clover Hay	32	7·0	4 7
Vetch and Oat Silage	13	1·6	1 12
Barley Straw	19	0·7	2 2
Wheat Straw	11	0·1	1 4
Bean Straw	19	1·7	2 5

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values" which it is recommended in the Report of the Committee on Rationing Dairy Cows should be applied by Agricultural Organisers and other advisers in connection with advisory schemes on the rationing of dairy cows, are given in the November issue of the Ministry's *Journal*.)

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MISCELLANEOUS NOTES.

Judging Pasture Competitions.

THE report of the Judge (Professor R. G. Stapledon, M.A., of the University of Wales) on the pasture competitions organised last autumn by the Brecon and Radnor (Joint) Agricultural Education Committee, possesses more than a local interest, since, in the absence of any traditional or accepted method of assessing such competitions, standards had to be specially devised by the Judge. The factors upon which the awards were based in these competitions are given in some detail in the report, and their consideration may be of value to other authorities or individuals who may be organising similar competitions in the future.

Four major difficulties that presented themselves to the Judge are given as:—(*a*) climate, soil and elevation; (*b*) the nature of the seeds mixture employed; (*c*) the intended duration of the ley; and (*d*) the size of the field and the salient features of management.

Between the respective fields in these competitions there were considerable differences in soil, elevation above sea level, exposure and rainfall experienced. Professor Stapledon is inclined to think that soil, rainfall and aspect are the three chief factors affecting sward formation, but knowledge of the rainfall distribution in the two counties was limited, and inspection was, necessarily, too hurried to permit full acquaintance with the nature of the soil. It seemed fairer to endeavour to give each field a handicap and not to adjudicate on the basis of the best sward independent of conditions; but the fixing of the handicap was the most difficult part of the Judge's task.

The difficulties of arriving at an impartial judgment were greatly increased under (*b*) as the conditions of entry did not call for a statement of the seeds mixture used, and the information was not in all cases forthcoming. Should the fields be judged

solely on the basis of the sward developed or should the success of the seeds mixture, as such, also be taken into consideration? Obviously, a man who has sown a great number of species, only a limited number of which have succeeded, has wasted money and, to that extent, shown a lack of skill. On the other hand, a man who has sown a poorly-blended mixture may, by skilful management, have obtained results as good as a neighbour who used a more sensible mixture. A unit of marks would have been awarded for "suitability of seeds mixture," but as information was lacking in some cases it seemed fairer to ignore this point in the competitions under notice.

The intended duration of the ley (*c*) is a fundamental point upon which the Judge, in many cases, was entirely in the dark, and unable to handicap competitors when the information could not be obtained. The conditions provided for two classes (1) leys seeded down during the years 1921 or 1922, and (2) leys seeded down during the period 1918-1920. It was safe to assume that class (2) leys were intended for long duration, and they were judged on that basis. The standards would be very different if judging either a third year of a three-year ley, or the third year of, say, a six-year ley. From the nature of the swards it seemed obvious that the vast majority of the competitors were aiming at something to last longer than four years. and the Judge felt compelled to adjudicate class (2) on the same basis as class (1), although this may have done an injustice to some of the entrants.

The minimum size of fields allowed under the conditions was three acres. Under (*d*) Professor Stapledon observes that it is a matter of extreme difficulty to compare accurately the merit of a sward. cut for hay practically every year over a three- to five-year period. with that cut only in the first year (or from which hay has never been taken) and grazed subsequently for three or four years. Particularly is this so, if the judge's ideas and ideals as to skilful grazing run somewhat counter to those of the locality; and it is even more difficult when it is realised that it is much easier to graze skilfully (*i.e.*, in accordance with modern scientific views) on small fields, of from three to six acres, than large ones.

The method of judging adopted was that of the score card, which Professor Stapledon considers the fairest one, although he feels that experience and discussion are needed to settle the proper allocation of marks. An equal number of marks were allotted for the following characteristics :—

(1) *Abundance of Wild White Clover.*—The point here was the abundance of white clover as a factor for making a good

long-duration ley, but the Judge had to decide whether the variety met with on the leys was Wild White (whether sown or unsown) or ordinary short-lived White Dutch.

(2) *Scarcity of Weeds.*—Greater exception was taken to the boar (spear) thistle than the creeping thistle, the former being more easily eradicated. Docks are difficult to avoid, but, as bad weeds, had to be considered. The best fields in the competition were so good, however, that exception to every sort of weed had to be considered in the marking.

(3) *Scarcity of Yorkshire Fog and of Bent.*—Although Yorkshire fog and bent grasses are often freely grazed by stock, grasses like perennial ryegrass, rough-stalked meadow grass, cocksfoot and the like are more palatable and more productive over a longer season, and therefore more valuable contributors to the herbage. For this reason excess of Yorkshire fog and bent led to "marking-down."

(4) *Scarcity of Rough Ungrazed Patches.*—Opinions about "foggy" or ungrazed patches may differ, some holding that they are unavoidable, harmless and afford "winter keep." The last is true to a certain extent, but the patches soon become "burned" and highly devoid of nutritive value, and, if they were not allowed to occur, a field would afford even more winter keep. Such patches frequently disclose centres of deterioration, and were penalised in marking where they contained far more weeds and/or bent and Yorkshire fog than the well-grazed parts. Fields, the body of which had been too hard grazed while patches had been entirely neglected, were also "marked down."

(5) *Success of Sown and Excellent Species.*—Wild white clover as under (1) was given a special unit of marks, but fields were marked more highly where several good species contributed to the sward than where but one good species may have contributed in great abundance. After wild white clover, the species most favoured were red clover, ordinary white Dutch clover, perennial ryegrass, cocksfoot, Timothy, rough-stalked meadow grass and, on the poorer fields, crested dogstail.

(6) *General Management.*—Under this were considered:—The proper rotational movement of feeding troughs and/or poultry houses when these were present; the state of fences and gates, since properly controlled grazing demands proper stock-proof fences and proper use of the gate; the question of the same field containing swards sown at different dates; no two swards requiring precisely the same grazing treatment, although

objection was not strong in the rare cases where the swards were very similar in character.

(7) *The Sward as a Whole.*—This allocation was used largely as a means of handicapping fields in relation to soil and climatic conditions. Another point was that a poor-condition field should not contain a higher proportion of rough patches than a good-condition one, for management can put this right, as, also, it can put thistles and docks right. Poor-condition fields were allowed rather more bent and rather more of certain weeds and were still marked high on this allocation. The general density and productivity of the sward in relation to conditions was also considered.

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Co-operative Marketing in the United States.

THE following extracts from the Annual Report to Congress recently presented by the Secretary of Agriculture in the United States Government are of interest:—

" The most distinct and significant movement in American agriculture in this decade is the almost universal trend toward co-operation in the marketing and distribution of farm products. It is in no sense a regional or sectional movement, for it exists in all sections and is participated in to some extent by producers of practically all kinds of farm products.

" There has been some co-operation by farmers in the United States for many years, but within the last two decades, and particularly during the last decade, the movement has assumed proportions which indicate that it is a response to a fundamental and universal need of present-day American agriculture. It is highly significant from all points of view that the best minds in agriculture, without regard to region or commodity, are unanimous in the opinion that group action in marketing must be added to individual efficiency in production if the high standards of American farm life are to be preserved and agriculture is to maintain its proper place in our national life . . .

" Although co-operative marketing is a farmers' movement, it is not in any proper sense a selfish class movement and holds no menace either to consumers or other business interests. Agricultural production is essential to national welfare, and the only guarantee of an adequate and dependable supply of agricultural products is a prosperous and contented agricultural population. It is obvious to any thoughtful mind that this

happy result cannot be obtained by agriculture unless it avails itself of the efficiencies and economies of organisation and specialisation which characterise other industries in this day. Consideration alike of intelligent self-interest and public welfare must prompt other classes to support wise and intelligent efforts of farmers to place their important industry upon a basis of stability and prosperity . . . . . '

"To place our agricultural production on a stable and profitable basis we must recognise the inseparable relation between production and marketing. The working out of a more efficient marketing system must go hand in hand with an intelligent adjustment of production to market demand in a more orderly manner so as to avoid periods of over-production with great loss and periods of under-production with prices unsatisfactory to the consuming public. That agricultural production may more readily become responsive to the market demands, the farmers will have to organise for marketing through the development of sound farmer-owned and controlled co-operative associations.

"I view co-operation in agriculture as a business agency serving the producers both as an intelligent guide in their production programme and an effective instrument for merchandising farm products. Instead of thinking of co-operation among farmers as a producing proposition or as a selling proposition, we need to think of co-operation as a business form or organisation that penetrates our whole agricultural industry. By this I mean co-operation, in an educational way, must reach back to production practices and forward through efficient business organisation to marketing practices. It is from this concept that I look upon co-operation as a ' business form or organisation ' adapted to the farming industry . . . . . ."

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THE following note has been communicated by Mr. J. A. Caseby, one of the Ministry's Small Live Stock Officers.

Durham Goat Society.

When the figures relating to the first season's matings under the Ministry's Stud Goat Scheme were published it was seen that Durham was one of the counties which had taken most advantage of this scheme for effecting improvement in goats. One stud goat at Bishop Auckland gave 42 services, and there were four stud goats available during the 1924-25 season from 1st September to 28th February. The Ministry's Census of Goats, taken with the assistance of the British Goat

Society, placed Durham, with over 3,000 goats, again amongst the leading goat-keeping counties.

During spells of duty in the county it was noted that goats were to be seen around all the villages and colliery banks. Investigation and visits to a number of breeders only emphasised the fact that in County Durham the miners, at least, realise the economic importance of the goat as a source of milk. Village goat shows are strongly supported; as examples may be mentioned Ushawmoor, which penned 65 goats, and Shildon, with over 80 goats, competition being keen and quality evident in full " bags."

Formation of the Society.—From conversations with breeders on the advantages of being organised, it was obvious that there would be support for any society which might be formed. A meeting was accordingly convened at which only some 16 people were present. It was explained, however, that the small attendance was due to the fact that some men were at work; night workers were resting; and others could not attend because of lack of funds to travel to Durham to the meeting. The meeting was enthusiastic about forming a society, each person attending promising to canvass for members. A second meeting was accordingly held in June, 1925, at which over 60 people were present and the objects in forming a society were stated to be :—

1, Improvement of goats in the county; 2, Encouragement of better methods of management; 3, Elimination of the scrub goat; 4, Provision of pedigree sires from milk - recorded dams; 5, Encouragement of milk recording; 6, Competition amongst goat keepers at shows; 7, Inter-county competitions; 8, Lectures on goat breeding during the winter; 9, Distribution of literature; 10, Educational visits to farms; 11, Development of a junior branch; 12, Register of breeders and " sales " and " wants "; 13, Co-operative grazing methods; 14, Affiliation of local horticultural and poultry shows; 15, Marketing of milk; 16, Formation of district executive committees; 17, Support of the Ministry of Agriculture's Stud Goat Scheme.

At this meeting Mr. Dolby (Deanbank) was elected Chairman and Mrs. Hendy (Etherley) Hon. Secretary. Rules were drawn up and the membership fee fixed at 3s. per annum. The membership is now over 100. It was decided to support two shows as a start with special prizes, to pay an educational visit in the summer and have four lectures in the winter.

Stud Goat Centres.—The society issues a printed member's card on which is given full particulars of 5 stud goats in the

county of Durham. One of these animals is "Garçon," an imported pure Saanen, which has been generously loaned by Miss Ballantine Dykes, of Chilworth, Surrey. The service fee to members is 2s. per animal mated, and to outsiders £1.1s. per animal. Fees collected go into the society's account and payment is made for Garçon's keep at 5s. per week. He stands at three places fairly far apart; staying one month at each. The other four male goats at stud are all large, hornless animals, pedigree bred from good milking strains.

Encouraging Young People to Start Goat Keeping.—Through the generosity of Miss Henderson (Hexham), and Mrs. Pickard (Garstang), respectively, the society has been presented with a 16-months old pedigree female goat and two half-pedigree bred female kids. These were given to the 3 boys in county Durham who first joined the society. It is anticipated that about a dozen female kids will be distributed in the spring.

Visit to Barnard Castle.—The society had an invitation to visit Mr. and Mrs. Pease's well-known pedigree stock farm at Sledwick, and were fortunate to go on a delightful day in September. Forty members proceeded from Durham and Bishop Auckland by motor. The herd of pedigree Anglo-Nubian goats was inspected, as well as pedigree shorthorns, thoroughbred horses and Cumberland pigs, while the goat houses, cow sheds and gardens were also visited.

Lectures.—Four lectures were delivered in the county by the writer during October and November, the lectures covering all points of importance concerning goat keeping. Leaflets were distributed at each lecture and large charts on goat keeping were shown, as well as pelts to indicate various breeds. Numerous questions were asked at the close of each lecture. The total attendance was 176, but some enthusiastic members attended two or even three lectures, although the centres were far apart.

At county shows next summer the society hopes to put before the public the value of goat's milk for invalids and incidentally to increase the membership of the society.

Future Activities.—The society hopes in the future to attain as many as possible of the objects stated in its programme and it certainly intends to keep closely in view the question of increased milk yield per head, and, by open competitions at shows, to encourage the spirit of competition which is so strong in the industrial areas of the north. The funds in hand will

enable the society to purchase a first Challenge Cup for competition at the next county show, where it is hoped to arrange classes for milch goats, goatlings and kids in each of the popular breeds.

The distribution of young stock to selected boys will be carried out in the spring, when it is hoped to start at least another dozen boys in goat keeping. Books on goat keeping may be obtained on loan from the Secretary, also leaflets issued by the British Goat Society and the Ministry; and a "sales and wants" Register is kept so that members may be assisted in the purchasing and selling of goats.

Mrs. Hendy, Etherly, Bishop Auckland, County Durham, Hon. Secretary of the society, who owns a herd of pedigree milk-recorded goats, states that many of the members are keen on improving the standard of goats kept and desire to purchase high-grade animals. This desire is not easily satisfied because it is seldom that really good animals are offered for sale, and then only at a price much beyond the purse of the labourer. The other course is to grade up existing herds by using pedigree sires from high milk-recorded dams, and to this end the five male goats registered in county Durham under the Ministry's Stud Goat Scheme will assist. The members of the society appreciate the value of this scheme and it is estimated that over 100 female kids will result from 1925 matings.

The Durham Goat Society has proved a success in its membership, but its strength lies in the enthusiasm of the members for the goat, not as a means of making money but because of its affectionate ways and for the valuable tuberculin-free milk of high digestibility which it gives at negligible cost in return for a little care and kindness.

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Farm Workers' Minimum Wages.

A MEETING of the Agricultural Wages Board was held on 12th January, at 7, Whitehall Place, S.W.1, the Chairman, Lord Kenyon, presiding.

The Board made an Order giving effect to a resolution received from the Middlesex Agricultural Wages Committee, fixing minimum and overtime rates of wages for all classes of male and female workers in their area, which came into operation on 26th January, and to continue for a period of twelve calendar months. The effect of the Order is to continue the present minimum rates unchanged, the rates in the case of male

workers aged 21 years and over being, stockmen, 41s. 3d. per week of 60 hours; carters, 38s. 6d. per week of 56 hours; other male workers, 33s. per week of 48 hours in winter and 34s. 4½d. per week of 50 hours in summer; casual workers, 8¼d. per hour. For adult female workers the rate are in the case of those employed as stockmen, 30s. per week of 60 hours; carters, 28s. per week of 56 hours; other workers, 24s. per week of 48 hours in winter and 25s. per week of 50 hours in summer; casual workers 6d. per hour. The overtime rates for adult workers are 10¼d. for males and 7½d. for females.

Copies of the Order in full can be obtained on application to the Secretary of the Agricultural Wages Board.

The next meeting of the Board will be held on Monday, 8th February, 1926.

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Short Course for Milk Recorders.

A SPECIAL Course in Milk Recording will be held at the University College, Reading, from the 23rd February, 1926, to the 13th March, 1926. Each day's instruction will embrace :—

(*a*) At least two hours' theoretical teaching.

(*b*) Practical work in weighing, sampling, testing and the keeping of milk records.

Applicants must be able to milk before admission to the Course.

At the conclusion of the Course, the Authorities of the University College, Reading, will notify in writing those students who have satisfied their Instructors as to their industry and general ability and who have passed both the theoretical and practical examination held during the closing days.

SYLLABUS.

a. *Lecture Course.*

1. *Milk.*—Nature and composition; causes of variation; Food and Drugs Act; regulations concerning Milk.

Bacteria.—Milk as a medium for bacteria; control of bacterial growth, importance of cleanliness; use of preservatives; the Milk and Dairies Act.

Testing.—Weighing, methods of sampling; simple and composite samples; determination of the percentage of fat; and of the specific gravity; the Gerber Test; the Lactometer, calculation and percentage of total solids from percentage of fat and specific gravity; calculation of averages.

2. The principles and practice of Milk Recording; the Ministry of Agriculture Scheme; why accuracy in detail is essential; discussion of the duties of Recorders, with a study of the forms which

must be kept; milk record certificates and register of dairy cows; interpretation of milk records; calculation of herd averages; Breed Societies, Records and Registers of Merit; marking of cows; calf and bull marking scheme; methods of keeping food records.

b. *Practical Work.*

Actual milk recording; the taking of simple and composite samples under various conditions; determination of the percentage of fat (Gerber method) and the specific gravity; calculation of total solids; use of the Richmond scale: visits to farms evening and morning to weigh milk and make the necessary entries; checking of records; detection of errors and abnormal results; keeping of food records, and calculation of cost of feeding and cost of food per gallon of milk.

The tuition fee for the Course will be £3. The College registration fee of 1s. must also be paid.

Board and residence is obtainable in the neighbourhood of the College, at rates varying from £1 15s. to £2 5s. per week, and addresses where such lodgings may be obtained will be sent on the applicant's request.

Applications for admission to the Course should be made not later than Thursday, 18th February, 1926, to the Dean, Faculty of Agriculture and Horticulture, University College, Reading.

Students are advised to bring cycles with them if possible, as some of the work will necessitate frequent visits to the College Farm.

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Research Work in Poultry Diseases.

IN connection with this work a case of pigeon pox is required for experimental purposes at the Ministry's Veterinary Laboratory. The disease manifests itself by wart-like nodules on the head. The Ministry will be grateful if any owner who has a pigeon suffering from this disease would send the bird (alive or dead) addressed to: The Director of Research, Veterinary Laboratory, Ministry of Agriculture, New Haw, Weybridge, Surrey.

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Kew Gardens Admission Fee.

WITH reference to visits of the public to the Royal Botanic Gardens, Kew, the Ministry in December last decided to re-impose, as from 1st January, 1926, on other than Students' days, the admission fee of one penny, which was abolished in April, 1924, and which previously yielded a revenue of about £5,000 per annum. The present admission fee of 6d. on Students' days (Tuesdays and Fridays) will continue to be charged.

Foot-and-Mouth Disease. — While the position generally has improved since the issue of the January *Journal*, new centres of disease have been confirmed at Ramsden Crays, Billericay, Essex, on 25th December; at Thornton Horncastle on 10th January; at Dishforth, Thirsk, Yorks (North Riding), on 15th January; and at Roydon, Essex, on 24th January. New outbreaks were also confirmed at Salford on 9th January, involving the maintenance of restrictions in an area from which they were to have been withdrawn a day later.

The number of outbreaks from 22nd-31st December inclusive was 11, making the total for the year 1925, 260, which involved 26 counties.

There have been 8 outbreaks in all during the current year to 24th January inclusive, of which three have occurred in Lancs., one in Stafford, and one in Lincolnshire; two in Yorks (North Riding), and one in Essex.

In view of the improvement in the general position, the Ministry felt justified in withdrawing the restrictions imposed by the Midlands and South of England (Regulation of Movement of Animals) Order of 1925 as from the 14th January, 1926, save only in respect of the counties of Lincolnshire (three divisions), Cambridgeshire, Isle of Ely, Soke of Peterborough, and Huntingdon. The restrictions were maintained in those counties until 17th January in consequence of the outbreak at Horncastle, Lincolnshire, and the suspicion attaching to the areas of distribution from Spalding and Cambridge markets, at which pigs involved in outbreaks at Salford on the 9th January were exposed.

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NOTICES OF BOOKS.

Crop Production, Poisoned Food and Public Health.—(John Hepburn. London: Crosby, Lockwood & Son. 7s. 6d.) Deals with an aspect of agriculture that, so far, has received but scant attention from the scientific investigator, namely, the cultivation of the soil.

Mr. Hepburn in his book discusses the conditions under which the three most important factors concerned with the growth of plants, viz., soil, water and air, can best be made to play their parts in the promotion of healthy, vigorous plant development, and in doing so he brings to bear the experience of a lifetime of practical farming coupled with an acuteness of observation and a flair for original investigation not often met with among British husbandmen.

Just as resistance to disease in man or animal has been shown to depend greatly on the health of the subject so the author demonstrates quite clearly that when soil conditions are adapted for normal vigorous growth the plant is relatively immune from attack by insect and fungoid pests. In the control of aeration and soil moisture he has relied largely on deep subsoiling by means of a tine of special pattern whereby the hard pan under the plough sole is broken up and the subsoil made to act as a reservoir for water to be drawn upon in time of drought.

Mr. Hepburn has, also by means of a coulter designed for shallow sowing, succeeded in obtaining a plant with a deep and widely ranging root system and a strong sturdy stem that is not liable to lie down.

Mr. Hepburn has by his methods of cultivation succeeded in controlling or entirely preventing bunt in wheat and aphis or "black fly"

in beans, and while some of his deductions may not be wholly warranted by the evidence adduced, there can be no doubt that he has made an important advance in the matter of cultivation and its effect on the incidence of disease.

Dairy Engineering.—(John T. Bowen, B.S. London: Chapman & Hall, Price 18s. 6d.) It may be suggested at once that this volume is unfortunately named, since it is scarcely a text-book on dairy engineering. The dairy industry makes considerable use of machinery of a special character. Apart from the machinery used in butter and cheese making, the manufacture of condensed and dried milk, and milk products generally, the direct supply of milk to the public involves the use of special machinery for cooling, cleaning and bottling, and the lay-out and general arrangement of a modern milk depot involves a great deal of engineering. There is also the question of the means adopted for the transport of raw milk, a matter in which the United States of America is perhaps in some respects ahead of us. All these matters should certainly have been covered in any book described as a treatise on dairy engineering. Yet the book under notice scarcely mentions any of them.

Further, there is no reference to milking machines, no mention of separators, and nothing but an incidental reference to bottling plant. Butter and cheese making are ignored. The layout of factories or creameries is not discussed. There is no mention of any of the problems connected with the transport of milk, which it is the business of the dairy engineer to solve.

The book is in fact rather a text-book on engineering than on dairy engineering, and, as stated in the preface, contains little new matter, information having been collected from various engineering sources and through the author's work in connection with the dairy industry. It seems likely that the author's intention was to compile a book which would instruct dairymen in engineering and take the place of an engineering course. For such a purpose the book would have its uses, though opinions will differ as to the value to the dairyman of much of the information given.

The character of the book may be judged from the fact that a chapter of eighteen pages is devoted to chimneys in which formulæ are given for calculating the theoretical draught, and the design of chimneys is discussed at some length. In the chapter on steam, tables of the entropy of steam and water are given. In the chapter on steam engines two pages discuss flywheels, and formulæ are given for calculating the velocity at which they will burst. There are nearly five pages on indicators and how to use them. There are nine chapters dealing with steam, boilers and engines. Separate chapters deal with the gasoline engine, with direct and alternating current motors, three deal with the refrigerating plant, and there are also chapters on the transmission of power, and temperature measurement and control.

The information given is sound, clearly set out and well arranged. The chapters on transmission of power and on temperature measurements may be specially commended, and in the chapter on exhaust steam heating—where the connection with the dairy industry is more closely maintained than elsewhere in the book—the special conditions of the industry and their bearing on the total economy of the plant employed are well brought out.

Reproduction in the Rabbit Biological **Monographs and Manuals.**—(No. IV. John Hammond, M.A. London and Edinburgh: Oliver & Boyd. 210 + xxxv pp. and Tab. xx. 15s. net.) This is the fourth of the series of Biological Monographs edited by Dr. Crew, of Edinburgh, and Mr. Cutler, of Rothamsted. The manual is primarily directed to the advanced worker, but as rabbit-farming is now a growing and profitable industry, much of its contents should be interesting to the practical man. The subject of sexual physiology had not received much attention from scientific workers until it was taken up by the Cambridge School some fifteen years ago in this country. The fact that the book under notice is published with the approval and support of the leading British authority on this subject—Dr. Marshall, of Cambridge—gives it an added interest. Mr. Hammond's treatise embodies much original work on the reproductive organs, and although nominally concerned with the rabbit, has, in fact, a much wider application. A chapter on the " yellow body " (*corpus luteun*) is contributed by Dr. Marshall himself, and is accompanied by a number of original microphotographs showing the successive stages of the development of this body before and after gestation: these alone constitute an advance on anything of the kind previously published. A very complete bibliography of the subject is a valuable feature.

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ADDITIONS TO LIBRARY.

Live Stock and Meat.

North Dakota Agricultural Experiment Station.—Bulletin 186 :—A Survey of Sheep Production on 200 Farms and the General Sheep Situation. (58 pp.) Agricultural College, N.D., 1925. [63.631.]

Ministry of Agriculture and Fisheries.—Departmental Committee on Export of Horses to the Continent.
Report. [Cmd. 2495.] (53 pp.) 1s.
Proceedings, &c. (412 pp.) 30s.
London : H.M. Stationery Office, 1925. [614.96.]

Ministry of Agriculture and Fisheries.—Economic Series No. 6 :—Trade in Refrigerated Beef, Mutton and Lamb. London : H.M. Stationery Office, 1925, 1s. 6d. [63.75.]

Ministry of Agriculture and Fisheries.—Departmental Committee on Rationing of Dairy Cows. Report. (47 pp.) London : H.M. Stationery Office. 1925, 6d. [63.711 : 043.]

Seale Hayne Agricultural College.—Pamphlet 17 :—The Cost of Food in Milk Production. Third Report. (21 pp.) Newton Abbot : 1925, 6d. [63.714.]

Veterinary Science.

International Institute of Agriculture.—La Prévention de l'Infection Charbonneuse parmi les Troupeaux. Resultats d'une Enquête Internationale. (155 pp.) Rome : 1925, 20 fr. [619.2(*b*).]

Poultry.

Second World's Poultry Congress.—Book of the Congress and Description of the Exhibition held at Barcelona 10th-18th May, 1924. (509 pp.) Barcelona : The Graphic Art Co.; London : National Utility Poultry Society. [63.65.]

Benjamin, E. W.—Marketing Poultry Products. Second Edition. (350 pp. + 7 coloured plates.) New York : John Wiley : London : Chapman & Hall, 1925, 17s. 6d. [63.741; 63.753.]

University College of Wales, Agricultural Economics Department.—The Poultry Industry of Wales. A Survey of Stocks, Methods and Prices, by *J. Morgan Jones.* (50 pp.) Aberystwyth : 1925, 1s. [63.65(429).]

Hodges, R. F. E.—Egg Production in the Home Country. (67 pp.) London : W. H. Smith & Sons, 1925, 1s. 6d. [63.65.]

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NOTES FOR THE MONTH.

The following statement of the Government's Agricultural Policy was issued as a White Paper on 2nd February:—

Agricultural Policy.

1. During the past year the agricultural situation has received the close attention of the Government, and a careful examination has been made of a large number of proposals and expressions of opinion submitted by agricultural organisations and others for the consideration of the Government in response to the invitation which was given by the late Minister of Agriculture.

2. There is a wide measure of agreement that a national agricultural policy should aim at securing the two following objects:—

(1) That the land should yield its highest economic possibilities in the way of food for the nation, and

(2) That it should furnish a basis of life and a reasonable livelihood to the greatest number of people.

3. There is, however, little or no agreement either in the agricultural industry itself or among the different political parties as to the measure that should be adopted to secure these objects. In these circumstances it is the duty of the Government to state the conclusions at which it has arrived as a result of its own consideration of the problem, bearing in mind the fundamental importance of protecting the industry from the danger of sharp reversals of national policy.

4. Increased production and greater employment would be secured by a large increase in the arable area, but it is clear that at the present level of corn prices, no such increase could be secured without—

(1) the imposition of protective duties on imported corn, which would be contrary to the pledges of the Government and to the policy of the other political parties, or

(2) the payment of some form of subsidy.

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5. The Government have considered various proposals which have been submitted to them involving subsidies, either direct or indirect, to encourage corn growing or the increase of the arable area, but they have come to the definite conclusion that they cannot support or advocate any of them. A subsidy may sometimes be justified as a purely temporary expedient or if it is required to start a new industry like beet sugar, but any general scheme of subsidies for agriculture is open to the gravest objection. They would have to be unlimited in duration and very large in amount to have any material effect in increasing the arable area or the number of workers employed. Even a subsidy of £2 an acre on arable land, which would amount to over £20,000,000 a year, would not necessarily result in any considerable increase, and in the present financial situation of the country, it is impossible to contemplate a large additional charge on public funds without any guarantee of a corresponding national benefit. Moreover, in view of the extreme variations all over the country in the quality or productive capacity of the land, it is impossible to devise any scheme of subsidies which will not result in the payment of a bonus to farmers who do not need it and for which no return will be received by the nation. The Government have also examined the question from the point of view of national defence and have come to the conclusion that no case has been made out on defence grounds which would justify the expenditure necessary to induce farmers in time of peace to produce more than economic considerations dictate. The maximum possible increase to the national food supply would be relatively small from the defence point of view in comparison to the cost involved. All proposals that have been made on the grounds of national defence have aimed at extending the area under wheat. None of these schemes could make the country self-supporting as regards bread-stuffs except at an impossible cost. On the other hand, from a purely economic point of view it will probably be better business for the British farmer to devote his energies as largely as possible to the livestock industry and to aim at meeting the demands of the population for meat and milk.

6. For all these reasons the Government are not prepared to recommend subsidies and they are also definitely opposed to any system of compulsory control of cultivation by committees or officials, which any direct financial assistance to the industry would be certain sooner or later to involve. Such con-

trol would, in the opinion of the Government, entirely fail to secure the objects in view, would be intensely repugnant to all classes concerned, and would, if persisted in, lead inevitably to the complete nationalisation of the whole farming industry of the country.

7. In the view of the Government, agriculture, of all the industries in the country, is the least adapted to drastic and spectacular action on the part of the State, and its present condition is not such as to justify revolutionary methods. In common with many other industries, it has been severely hit by the fall in prices after the War, but it is weathering the storm and there is no reason to fear that it will not adapt itself to the economic situation.

8. In these circumstances the right course in the best interests of the industry itself and of the nation as a whole, is to proceed on the lines of education and encouragement rather than of coercion, to endeavour to create that confidence which is essential for progress, to stimulate the private enterprise of those engaged in the industry, to assist them to organise themselves on an economic basis, and to protect them from the dislocation of reversals of policy and from rash proposals which would impair progress and breed insecurity.

9. On those lines the Government believe that useful assistance can be given in many directions, and in the forefront they would place the question of credit. For its proper development and extension agriculture is in need of additional capital. The landowners of the country are to an increasing extent less able than formerly to supply what is needed for permanent improvements, credit is needed for the development of occupying ownership to which the Government attach great importance, and many farmers are seriously short of working capital, particularly if they have bought their farms. In these circumstances the Government are giving special consideration to the whole subject and discussions are proceeding with a view to the preparation of a scheme on a sound commercial basis for short term credit, credit for improvements and credit for land purchase, with the object of bringing the general credit machinery more into line with the existing economic needs of the industry.

10. The Government believe also that production and employment on the land can be increased by a development of small holdings on sound lines. Owing to the claims of the ex-service applicants, it has not been possible since the War to

provide any facilities for the acquisition of land by large numbers of men who have the necessary knowledge and capital and who desire opportunities of obtaining an independent position as small-holders. It is proposed, therefore, to introduce legislation empowering County Councils to continue and extend the provision of small holdings and cottage holdings both for owner occupiers and for tenants. Provision will be made whereby the *bona fide* agricultural worker will be assisted to acquire as his own property a cottage and a small area of land which he can cultivate as an addition to his other earnings.

11. The position of the workers in agriculture is dependent on the relative prosperity of the industry as a whole, and the Agricultural Wages Regulation Act, which the Government are pledged to maintain, ensures that the wages paid are the utmost that the industry can afford. The proposals for small and cottage holdings and the facilities for the provision of allotments, which have recently been extended, offer opportunities of advancement to workers on the land, and the Rural Community Councils, the Women's Institutes and other agencies for the revival of rural industries and the social improvement of village life are doing much, with the aid of grants from the Development Fund, to increase the amenities of the countryside and to improve the lot of all classes of the rural population. The Government will do all in their power to foster and support this movement.

12. Large areas of land in many parts of Great Britain are more suited to the production of timber than food. An adequate supply of growing timber is also highly desirable on grounds of national defence. The development of Forest Policy is largely dependent on State action continuously applied over a period of years. The Forestry Commission was established to carry out such a policy and is actively engaged on a definite programme, including the afforestation of 150,000 acres in the 10-year period 1919-29, the encouragement of private forestry by a system of grants, and the systematic establishment of forest workers' holdings at the rate of five holdings per 1,000 acres of afforestable land. It is anticipated that these holdings, the occupiers of which are guaranteed 150 days work per annum in the State forests, will make a useful permanent addition to the rural population, especially in poor grazing districts. The Crown Woods and Forests, including about 60,000 acres of woodland, have also been transferred to the Commissioners.

The Government has agreed that this policy shall be carried on without interruption.

13. One of the most serious impediments to greater production is the waterlogged condition of considerable areas in different parts of the country. In many cases the cost of the necessary drainage works to remedy the defects is greater than the land can bear, and accordingly the Government propose to ask Parliament to vote a total sum of £1,000,000 spread over the next five years to be expended in grants in aid of the cost of carrying out approved drainage schemes undertaken by Drainage Authorities. In order to deal with smaller schemes in areas where there is no Drainage Authority, it is proposed to introduce a Bill empowering County Councils to carry out the necessary work and recover the cost.

14. The question of the marketing of agricultural produce was thoroughly examined by the Linlithgow Committee and has since been developed in the series of Economic Reports published by the Ministry of Agriculture. The main initiative in this matter must come from the farmers themselves, and in face of the increasing competition in our home markets of imported foodstuffs of steadily improving quality, it is of the first importance that British producers should aim at suppying produce of the highest possible quality and should pay great attention to studying the markets and the taste of the British public. The Government are prepared to consider sympathetically any applications for assistance to sound schemes of co-operative organisation, and in this connection the Government propose to include home produce within the scope of any assistance that may be given to the marketing of Empire produce. It is also hoped that the credit proposals will be of considerable service in helping to finance the development of co-operative marketing. In addition, the Merchandise Marks Bill which will be introduced this Session will provide for the marking of imported agricultural produce so far as practicable, and the question of introducing a system of Cash-on-Delivery is under consideration.

15. The work which has been done in recent years in creating and maintaining a comprehensive scheme of Agricultural Research and Education, in providing an advisory service in technical agriculture, in economics and in farm costings, and in promoting Live Stock improvement, will be continued and developed; and the Government will recommend to Parliament that the funds necessary for the purpose shall be made available when the existing grants come to an end.

16. The provision of more and better housing accommodation in rural areas is a factor of great importance in the development of agricultural prosperity. Substantial and increasing progress is being made in the provision of new houses by Rural District Councils under the Act of 1924, and the Minister of Health is considering means of facilitating the improvement and reconditioning of existing rural cottages.

17. The policy adopted in recent years of making grants from the Road Fund towards the improvement of unclassified roads in rural areas, under which sums amounting to £4,250,000 have already been allocated in England and Wales, has resulted in a considerable relief to the burdens falling on the occupiers of agricultural land. This policy will be continued and extended so far as funds permit, and further rating relief will result from the recent decision of Parliament that farm buildings should be assessed under the Rating and Valuation Act on the same basis as the agricultural land with which they are occupied.

18. One of the most important functions of the Government in relation to agriculture is to provide adequate protection from the inroads of disease, whether of animals or of plants. This work will be steadily pursued, and in particular, the Government intend to maintain the policy of eradication in regard to foot-and-mouth disease, believing as they do that, in spite of the heavy cost in recent years, it is far cheaper to the nation and the agricultural industry than an abandonment of the attempt to get rid of a disease which causes such devastating losses in countries where it has got out of control. At the same time the Government will continue to support in every possible way the scientific investigations which are proceeding in the hope of discovering the basis of a less destructive and expensive policy.

19. Finally, the Government will continue the policy of fostering the development of the sugar beet industry under the Act passed last year. It has already made most promising progress, has been of great assistance to many arable farmers, is proving of increasing value in regard to the problem of employment, and is laying the foundations of a more prosperous agriculture by the permanent establishment of a new industry on the land of great value to the nation as a whole.

20. All these measures taken together will in the opinion of the Government go far to provide the assistance and confidence which are required to enable agriculture to make its proper contribution to the life of the nation, and will enable all classes engaged in the industry to organise their business on a sound

economic basis. Such methods will be far more effective than any alternative policies of a drastic and revolutionary character which would impose great burdens on the State, would utterly destroy confidence and stability, and would subject the whole industry to a form of control and bureaucratic interference which would stifle enterprise and initiative.

21. Subject to the modifications rendered necessary by differing conditions these proposals, including any steps which may be taken to deal with housing in rural areas for the improvement and reconditioning of existing rural cottages, will apply to Scotland.

The provision of long term credit is equally important to Scotland where occupying owners are increasing.

Legislation will be introduced to empower landowners to combine for the execution of arterial drainage work and to enable assessments to be made to cover the costs of the works. The grants from the Road Fund will be continued in Scotland as in England. The development of the Sugar Beet Industry will be encouraged on the same lines as those which promise to be successful in England. The proposals contained in this statement deal with a considerable proportion of the recommendations of the Scottish Conference on Agricultural Policy, and they should assist Scottish Agriculture to develop on sound and profitable lines.

* * * * * *

Agricultural Credit.

THE Ministry has just issued a Report which gives a general review of the problem of agricultural credit in this country, and deals both with short-term credit for ordinary current trading purposes, and long-term credit for the purchase and improvement of agricultural holdings.*

This Report, prepared at the request of the Ministry by Mr. R. R. Enfield, one of its officers, begins by contrasting the general economic and financial structure of modern agriculture with that of the joint stock industry, and points out that agriculture must rely on credit for some of its working capital, where the joint stock industry largely relies on public subscription. It then examines the needs for credit, particularly as regards marketing. It calls attention to the factors bringing about the marketing of agricultural produce too hastily, causing a temporary congestion of markets and a fall in prices. Financial pressure is often described as the chief of these causes, and the

*Agricultural Credit (Economic Series No. 8), which is obtainable from His Majesty's Stationery Office, Adastral House, Kingsway, W.C.2, price 1s. 6d.

object of what may be called "marketing credit" is to enable farmers to exercise their judgment as to the right time to sell, free from the pressure which recurring seasonal charges sometimes impose upon them.

In the third chapter, the Report examines the present sources of farmers' credit—the banks, tradespeople and landlords. While recognising the services performed by tradespeople, it suggests that, in principle, the habit of raising credit by contracting a large number of debts with dealers, merchants, and auctioneers is a bad one. One essential condition of a sound credit system is that borrowers should know what credit costs. When they borrow from tradesmen they often do not know. This practice also sometimes involves the farmer in certain entanglements with his creditors of an undesirable kind. To free him from these entanglements should be one of the objects of a rational credit system.

In regard to short-term credit, the Report lays emphasis on the fact that for the most part British agriculture is conducted by tenant farmers, and that the main assets of tenant farmers are the stocks and crops upon the farms. It is suggested that any system of short-term credit, if it is to be of the utmost use to farmers, should enable them to obtain credit on the security of these assets. The value of stocks and crops on the farm far exceed any other assets that tenant farmers usually possess, and should supply ample security for any loans the farmer may require for current trading purposes. The difficulty of the present machinery is that no satisfactory means exist of raising credit on the security of stocks and crops. It is therefore suggested that legislation should be enacted enabling a valid charge in the form of a chattel mortgage in favour of the banks to be given upon these assets.

The Report also suggests that agriculture requires credit in the form of long-term mortgage loans repayable by fixed yearly or half-yearly instalments, in order to finance the purchase or improvement of agricultural holdings. It points out that Great Britain occupies an almost unique position in having no established machinery of long-term agricultural credit based on farm mortgages (with the exception of the restricted machinery provided under Section I of the Agricultural Credits Act, 1923). It proposes that to meet this difficulty a *central land bank* should be established to make long-term loans through the existing joint stock banks, and that it should be empowered to raise money for the purpose by the issue of debentures to the public.

It is believed that such a scheme should have the following advantages :—

(1) It would establish for the first time in this country a uniform standard system of long-term mortgage credit for agriculture.

(2) It would give new facilities to farmers who wish to purchase their holdings by providing mortgage credit at a reasonable rate of interest in a standard and universally applicable form, and free from the risk of unexpected foreclosure.

(3) It would create a standard agricultural investment, thus opening up a new channel through which capital could enter agriculture.

(4) It would be administered through the joint stock banks and would have the benefit of their knowledge and experience. It would be simple and secret.

* * * * * *

The Journal.

FOLLOWING this issue of the *Journal*, completing Vol. XXXII, there will be a change in the publication arrangements, the responsibility for these, from 1st April onwards, being undertaken by H.M. Stationery Office. All subscriptions for the *Journal*, accruing on and after that date should, therefore, be forwarded to that Department at Princes Street, Westminster, London, S.W.1. Copies of the *Journal* will, however, continue to be sold at the Ministry, 10, Whitehall Place, London S.W.1. The Editorial arrangements remain unchanged, and all correspondence on Editorial matters, articles submitted, etc., should be addressed to the Ministry as heretofore.

* * * * * *

Lucerne Growing.

IT is somewhat difficult to determine exactly why lucerne has made so little headway in England. It is, however, possible that the main reason is that farmers are under the impression that lucerne is a "difficult" crop, which can only be successfully grown on certain soils and under special conditions. It has long been known that this is by no means the case, for the crop is grown luxuriantly on both calcareous loams and on the London clay—quite extensively in Essex. The main desiderata for success are a fertile soil containing an adequate quantity of lime—natural or added, together with phosphates and potash; good drainage; a well-prepared and really clean seed-bed, with fine tilth; sowing by drill to a depth of one-half to one inch; care that in the

first and second years it is kept free from weeds. It may or may not be sown in a light corn crop; time of sowing may vary somewhat according to climate; and it will be the better if it is sheltered from the north and east and is on a gentle slope.

One point should be borne in mind, and that is that in the year of sowing the plant may appear to be so poor as to suggest failure, and this may conceivably be a reason why so many farmers think it is not suitable for their soil. A thorough harrowing may effect a wonderful change, and it is commonly desirable to try this before accepting defeat and ploughing under.

Further, in some cases the soil may not contain the right nitrifying bacteria which are essential to successful growth of the plant. *When any farmer fails to grow lucerne he should not give up but consult the County Agricultural Organiser.*

It may be emphatically stated that there is no crop which can be grown in this country which will better pay farmers to grow, or on which he is better justified in spending money to establish, than lucerne. After the first year it affords three or four heavy cuts, equal to 12 to 20 tons, of green fodder per annum for about six years—often eight and even ten years; it may be converted into magnificient hay of high feeding value, which will save much expenditure on concentrates; it may be made into excellent silage; it is very valuable, either green or in the form of hay, for horses and cattle; it is extremely useful for grazing pigs; its deep-seated roots have a wonderful effect in improving the physical condition of the soil; when once established it is practically independent of surface moisture, growing luxuriantly during the most severe drought; and when finally ploughed down adds so much nitrogen to the soil that several corn crops may be taken in succession without added nitrogen.

It may be added that so highly valued is lucerne in Argentina that the area now grown is greater than that of wheat, the figures for 1925 being—lucerne 19,500,000 acres, wheat 19,198,000 acres. Indeed, it is certain that it is lucerne which is the basis of Argentine wheat and meat production. In the United States the area has grown from about 2.000,000 acres in 1919 to 10,500,000 acres in 1925. In Canada the area in 1910 was only 58,818 acres (less than it then was in England and Wales), but in 1925 it had grown to 400,000 acres. Compared with these figures, and making allowance for the agriculture and size of the respective countries, the 54,000 acres grown in England and Wales in 1925 is a bagatelle.

Farmers throughout the country should study the article at p. 1089,* *and then proceed to lay down a few acres of lucerne this season*, taking pains to make it successful. If they do this their area in future years will surely grow.

* * * * * *

Bee-keeping: Examination and Certification of Apiaries.

THE Ministry desires to give notice that arrangements have been made for the inspection, on application, of apiaries where bees are raised for sale. Where no brood diseases are found to be present in an apiary, an official certificate to that effect will be issued. For the present, it will not be possible to include Acarine disease in the scheme, and the certificates will relate solely to freedom from brood diseases, though they will not be issued for apiaries where Acarine disease is seen to be present. The frames containing the combs of the colonies that are passed on inspection will be stamped to that effect, and this will afford protection to the purchaser.

Owners of apiaries where bees are raised for sale are invited to make early application for inspection. All applications should be addressed to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1. Fees at the rate of £2 2s. per day, with a minimum of £1 1s., will be charged for this service.

* * * * * *

The Agricultural Index Number.

As in each of the past three years, the general index number of the prices of agricultural produce has again shown a sharp rise in January. These increases have been due very largely to the fact that the prices of most agricultural commodities were lower in January than in December of the base years 1911-13, potatoes and hay being the only important exception. The index number for January this year is 58 per cent. above pre-war, a rise of 5 points on the month but 12 points lower than a year earlier.

The following table shows the percentage increases as compared with pre-war prices each month since January, 1921 :—

*See also Leaflet No. 160 (*The Cultivation of Lucerne*), to be obtained free of charge on application to the Ministry.

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH	1921.	1922.	1923.	1924.	1925.	1926.
January ...	183	75	68	61	70	58
February ...	167	79	63	61	67	—
March ...	150	77	59	57	65	—
April ...	149	70	54	53	58	—
May ...	119	71	54	56	57	—
June ...	112	68	51	58	55	—
July ...	112	72	53	52	51	—
August ...	131	67	54	59	56	—
September	116	57	56	60	57	—
October ...	86	59	51	63	53	—
November	79	62	53	64	53	—
December	76	59	56	63	53	—

Grain.—The average prices of wheat and oats were exactly the same in January as in December, but barley declined by 2d. to 10s. 6d. per cwt. The index number for wheat remained unchanged at 67 per cent. above pre-war, the average price during January being 12s 3d. per cwt. Barley and oats were relatively cheap, the index figures for these grains being 31 and 35 per cent. respectively above 1911-13. Wheat was 8d. per cwt., oats 9d. and barley 1s. per cwt. cheaper than in January, 1925. Apart from hay, barley was again relatively the cheapest of any agricultural produce.

Live Stock.—There was practically no change on the month in the average price of fat cattle, but as a result of the lower base price the index number rose by 8 points to 52 per cent. above pre-war. Fat sheep at an average of 12¼d. per lb. were rather dearer than in December, but the greater part of the advance of 16 points in the index number was due to the reduction in price which took place in January of the base years. After rising each month from midsummer until December, 1925, prices of pigs were practically unchanged in January. Fat pigs were relatively dearer than any other agricultural produce, the index number being 94 per cent. above 1911-13. As compared with January, 1925, fat pigs were dearer by about 2s. 6d. per stone, fat sheep were cheaper by 3¼d. per lb., and fat cattle were unchanged. The change in the prices of store pigs and sheep as compared with a year earlier were in the same direction as those for fat stock, pigs being dearer and sheep cheaper, while store cattle and dairy cows were cheaper than in January, 1925.

Dairy and Poultry Produce.—The index number of milk prices was unaltered in January at 74 per cent. above 1911-13. Butter declined by 2¾d. per lb. on the month, this reduction being unusually heavy for the time of year and the index figure

declined by 15 points to only 53 per cent. above pre-war Cheese prices were, however, unchanged on the month, [illegible] rise of 8 points in the index number [illegible] price in the corresponding month of the base years. There was a sharp fall in egg prices, these averaging 2s. 2¼d. per dozen against 2s. 11¼d. per dozen in December, but the index number was only reduced by 4 points to 70 per cent. above 1911-13, which was, however, 12 points lower than a year earlier. Poultry at 56 per cent. above pre-war were also cheaper than in January, 1925.

Other Commodities.—There was practically no change in potato prices as between December and January, but with the basic price for January some 5s. per ton higher than that for December, the index number fell sharply to 53 per cent. above 1911-13. Other vegetables averaged 97 per cent. above pre-war. Brussels sprouts, which advanced 4s. per cwt. on the month, were very dear, being 2½ times the pre-war price, and the index number for carrots was very similar. Celery sold at double the pre-war price and cauliflowers at 82 per cent. above 1911-13, cabbage and onions at 50 and 54 per cent. respectively above 1911-13 being relatively cheap. Hay prices were rather better in January, but the index figure remained unchanged at only 4 per cent. above 1911-13.

Index numbers of different commodities during recent months and in January, 1924 and 1925, are shown below :—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	1924.	1925.				1926.
Commodity.	Jan.	Jan.	Oct.	Nov.	Dec.	Jan.
Wheat ...	34	76	40	49	67	67
Barley ...	34	81	44	35	29	31
Oats	38	46	33	30	32	35
Fat cattle ...	56	52	48	48	44	52
Fat sheep ...	87	107	62	63	47	63
Bacon pigs ...	35	57	70	79	86	94
Pork pigs ...	49	59	71	75	84	94
Dairy cows ...	51	53	48	42	—†	42
Store cattle ...	35	43	32	32	—†	33
Store sheep ...	91	102	69	68	—†	57
Store pigs ...	63	49	88	97	—†	121
Eggs... ...	85	82	90	80	74	70
Poultry ...	60	63	48	49	60	56
Milk	87	84	74	74	74	74
Butter ...	68	73	71	71	68	53
Cheese ...	76	49	77	75	74	82
Potatoes ...	129	152	53	60	64	53
Hay	—1*	1	1	—1*	4	4

* Decrease.

† Very few markets for store cattle were held during December on account of Foot-and-Mouth Disease restrictions.

A WELSH FARMERS' CO-OPERATIVE SOCIETY:

AN INTERESTING VENTURE.

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ANYONE who has given any serious study and thought to agricultural co-operation in this country, must undoubtedly come to the conclusion that here, at any rate, co-operation applied to the purchase of agricultural requirements, has made greater progress than co-operative marketing.

In 1891, for example, a Committee was appointed by the Central Chamber of Agriculture to consider and report "by what means the organisation of the Chamber could be utilised so as to promote the co-operative principle for the benefit of all its members, *in the purchase of farming requisites.*" The Committee reported in 1893 that they had been impressed with the "advantages which may accrue to farmers by the adoption of the principle of co-operation. It is evident that with careful management the risk of failure is small, as is proved by the fact that, so far as the Committee have been informed, no agricultural co-operative association formed for the purpose of purchasing farming requisites has failed. The Committee, therefore, very strongly urge the consideration of this subject on the members of the Central and Associated Chambers of Agriculture, in the belief that not only might articles of guaranteed quality be procured at prices less than individual purchasers can as a rule be charged, but that by incorporating this object among the primary functions of farmers' associations an incentive to combination will be provided, and a greater union of the agricultural community will be secured."

Largely, possibly, as a result of this spade work of the Central Chamber, in 1893, thirty such associations, mainly joint stock companies, were in existence.

A steady increase in the numbers of farmers' co-operative purchase organisations commenced in 1901; and the adoption of the alternative system of registration under the Industrial and Provident Societies Act, also became more general.

Ten new societies for the co-operative purchase of agricultural requisites were formed in 1901, thirteen in 1902, and sixteen in 1903. The number continued steadily to grow

until in 1919, two hundred and fifty were in existence, since when the number of societies has steadily decreased, although the membership has actually increased.

Period.	Number of Requisite Societies.	Membership.	Turnover.
1900	11	1,200	59,000
1908	114	10,000	709,849
1914	198	24,000	1,700,000
1919	250	40,000	4,750,000
1921	231	56,000	11,500,000
1923	193	60,066	8,203,580

This rapid growth of the movement in the early part of the twentieth century was particularly noticeable in Wales—probably accounted for by the fact that, at that time, agricultural requirements were being supplied to Welsh farmers, particularly those in the remote districts, on terms which compared unfavourably with the terms obtainable in most parts of England.

Of the eleven co-operative requisite societies in existence in England and Wales in 1900, not one was in the Principality; of the thirteen societies formed in 1902, nine were in Wales. At the end of 1923, of the 193 societies in existence, 118 were English and 75 were Welsh.

A Welsh Society.—During the past year an opportunity was found of visiting one of the Welsh societies, founded in 1908 by a little group of seventy-seven Welsh farmers, who, with a share capital of £48 7s. 6d., banded themselves together to form a "Farmers' Co-operative Society, Limited."

The success of this little venture has been so phenomenal, its progress so striking, a study of its financial accounts, placed unreservedly into my hands, has proved so fascinating, that it seemed worth while giving it wider publicity, in the belief that it would prove of general interest.

During the seventeen years of its existence, the total sales have amounted to nearly £250,000, the turnover steadily increasing from just over £1,000 in 1908, to nearly £33,000 in 1924.

The sales per member have increased from £13 6s. in 1908 to £269 10s. in 1924, and have averaged £144 15s. per member per annum throughout the 17-year period.

The total net profit made by the society throughout the seventeen years of its existence has amounted to more than £6,500, a total yearly average of about £384, or rather more

than £4 per member. As the actual subscribed capital has amounted only to £94 17s. 6d., or less than 16s. per member, this has corresponded to an average net return of five hundred per cent. on the share capital subscribed by the members—surely a return sufficiently remunerative to satisfy even a Shylock.

TABLE I.

Year	Membership	Capital			Sales			Profits			Reserve		
		£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
1908	77	48	7	6	1,027	15	2	—83	1	5	—		
1909	78	49	7	6	1,852	15	3	—35	11	3	—		
1910	80	51	7	6	2,454	14	0	—39	11	2½	—		
1911	80	51	7	6	2,626	15	10½	—48	2	1½	—		
1912	80	51	7	6	4,230	18	4½	87	17	2½	0	3	10½
1913	80	51	7	6	5,418	2	8½	3	11	2½	3	15	1
1914	80	51	7	6	6,020	12	9½	97	13	0	101	8	1
1915	80	51	7	6	9,448	12	4½	158	12	2½	261	5	3½
1916	86	56	7	6	12,457	19	10	419	16	2½	679	16	6
1917	97	67	2	6	15,258	6	2	507	2	6	1,186	19	0
1918	104	74	2	6	14,686	18	0½	385	11	6½	1,572	10	6½
1919	105	75	2	6	16,974	4	4	366	8	4½	1,938	18	11
1920	110	80	2	6	27,629	1	5	471	8	9½	2,410	7	8½
1921	112	82	2	6	28,339	18	7	1,576	17	8	3.987	5	4½
1922	114	84	2	6	23,950	15	2½	958	11	3	4,945	16	7½
1923	118	1,191	17	6	26,101	9	10	771	18	8½	4,617	15	4
1924	121	1,194	17	6	32,645	10	11	928	8	5½	5,470	11	3½
Total	—	—			231,124	10	10½	6,527	11	1½	—		
Average	94	194	16	0	13,595	11	3	383	19	5	1,598	12	7

In an ordinary business, high profits may be the result of (*a*) good buying, (*b*) good selling, (*c*) low working costs, or (*d*) high capital turnover; and in the really successful commercial venture, it is most probable that all four will play their part.

In the case of a single-purpose society, like an egg collecting station, a bacon factory, a co-operative creamery, or a society for the co-operative marketing of wool, it is quite a simple matter to see how far the price paid by the society varied above or below the normal market price. In the case of a trading concern of the present description, where a very varied selection of foodstuffs, fertilisers, and even household requisites. are being purchased for sale to the members, this does not become anything like so easy.

Buying and Selling; Discounts.—A study of the balance sheet and trading account (Table II), however, does give some indication as to whether the society is likely to be in a position to take full advantage of the discounts which are allowed for prompt settlement of the accounts.

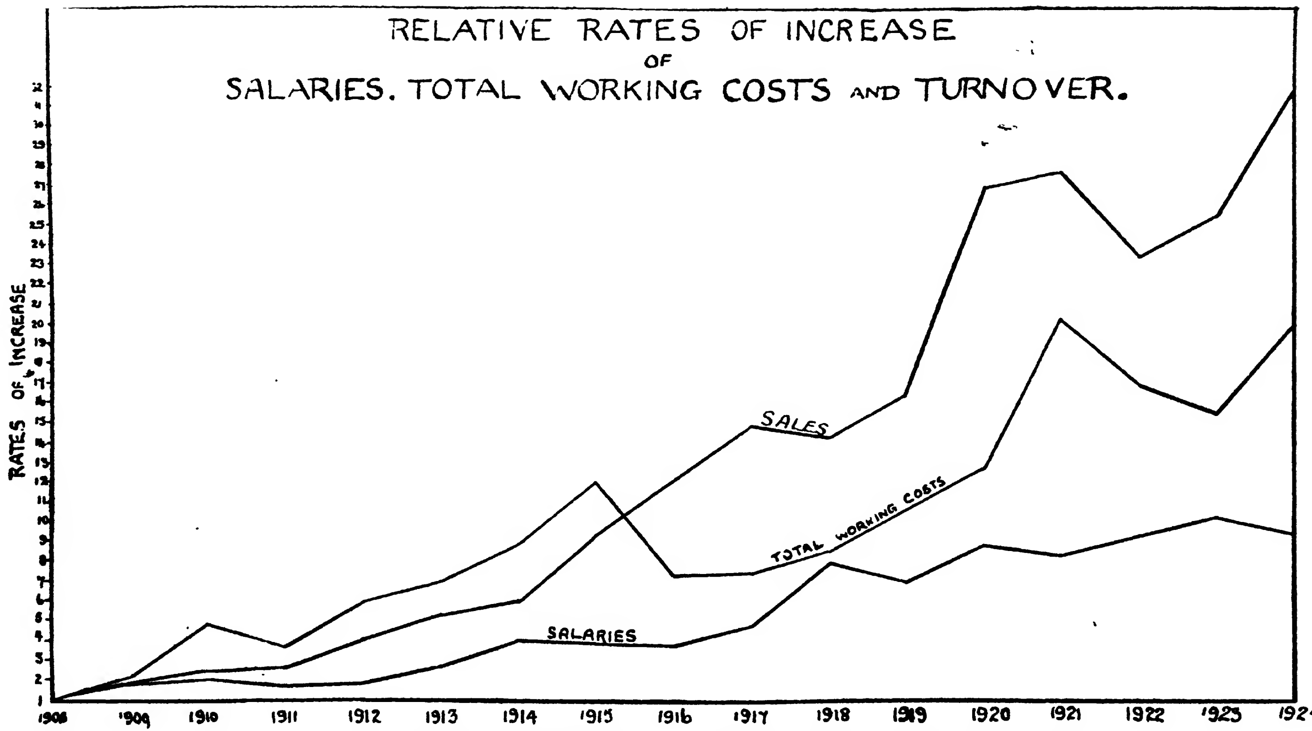

FIG. 1.—Showing Relative Rates of Increase of Salaries, Working Costs and Turnover.

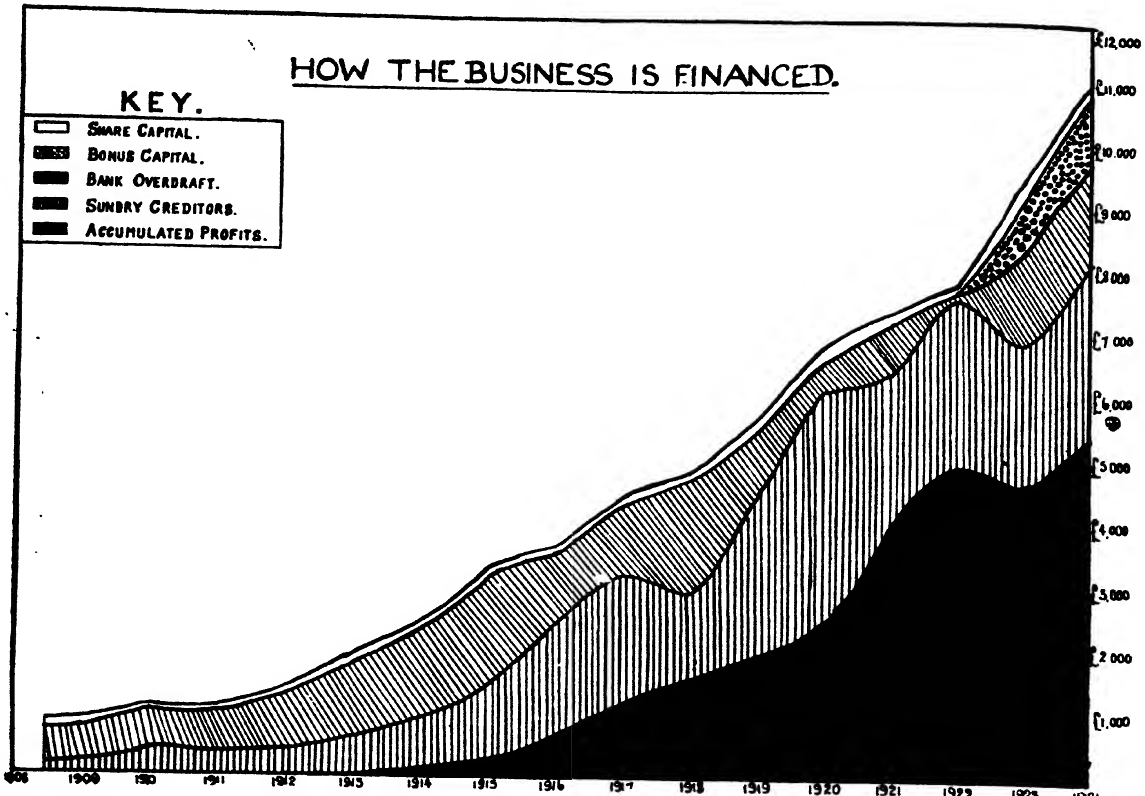

FIG. 2.—Showing how the Society has been Financed.

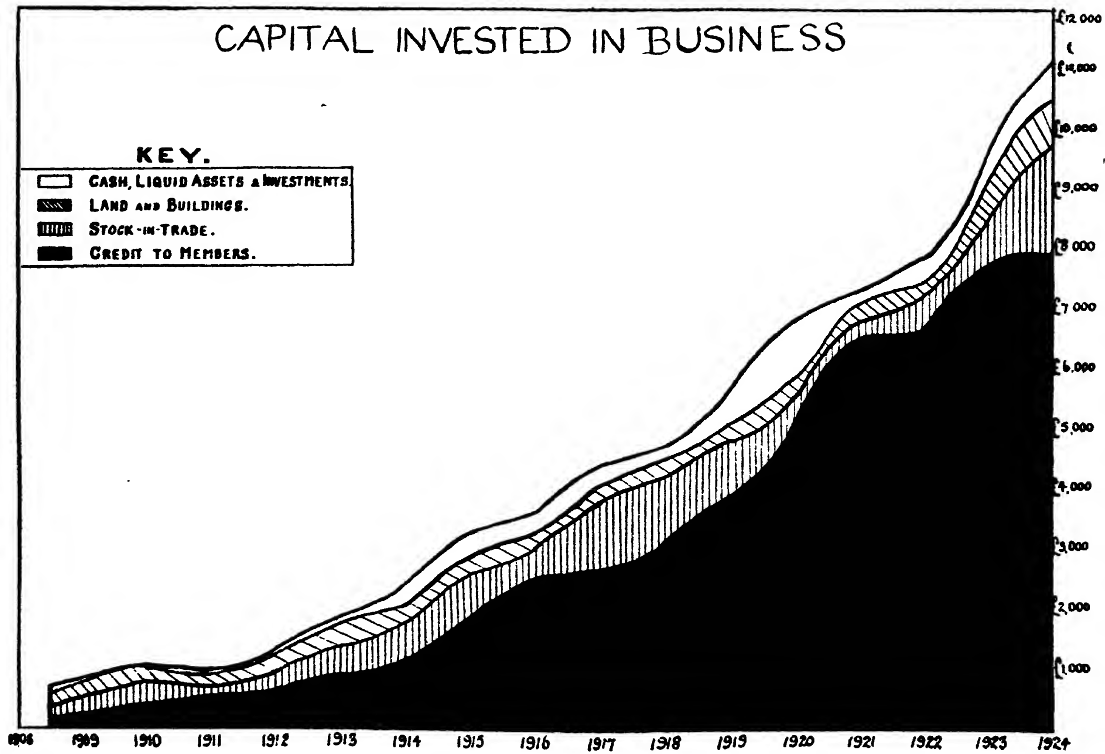

FIG. 8.—Showing the Capital invested in the Society.

From these accounts of the society it will be seen that, at the end of the financial year, 1924, the outstanding accounts owing by the society amounted to £2,781 19s. 0d., and the purchases for the year to £30,179 17s. 3d. In other words, there remains unpaid approximately 34 days' or, roughly, five weeks' supply.

A study of the records for previous years, reveals the fact that this is no isolated case, for during the seventeen years of the Society's existence they have been on the average forty-five days, or well over six weeks, and occasionally as far as two months behind with their payments.

With one of the firms with whom they largely deal, giving in the case of cake 7s. 6d. a ton discount for payment within a fortnight; and 5s. within a month, and fourpence in the £ on grain if paid within seven days, practically the whole of this discount will have been lost through failure to make prompt payment. Evidently, therefore, while the buying may have been good, it cannot possibly have been too good, and great as has been the success of the Society, it might undoubtedly have been still greater had the ready money been available for meeting the bills when they became due.

It is suggested, therefore, that the phenomenal success of this society has not been altogether due to good buying; nor is it likely to have been due altogether, or even principally, to good selling. Good selling is often looked upon as being synonymous with selling at a high price. Had the agricultural requisites sold to the members been disposed of well above the market price in the locality, it would have been putting a strain upon their loyalty, which must have shown its influence on the sales. When the sales have steadily and consistently increased and never looked back, growing from £1,027 to £32,645, an increase of well over three thousand per cent. and when the sales per member have also shown a steady and increasing improvement, growing by leaps and bounds from £13 6s. per member in 1908 to £269 10s. per member in 1924, it may reasonably be assumed that produce has not been sold to members at figures well above their market prices.

While, however, the success has not been due altogether to good buying or good selling, neither of these has been all bad, as can be seen from a study of the gross margin, which throughout the whole period has averaged 6.6 per cent. of the gross sales or 7.2 per cent. of the purchases.

TABLE II.—BALANCE SHEET AS AT 31ST DECEMBER, 1924.

DR. LIABILITIES.

	£	s.	d.	£	s.	d.
To Share Capital forward ...	1,191	17	6			
Ditto, introduced	3	0	0			
				1,194	17	6
N.P. Bank (Overdraft) ...				1,652	18	0
SUNDRY CREDITORS :—						
Capital	35	10	10			
Trade	2,684	11	2			
Expense	61	17	0			
				2,781	19	0
RESERVE FUND				1,000	0	0
PROFIT AND LOSS APPROPRIATION A/c ...				4,470	11	3½
				£11,100	5	9½

ASSETS. CR.

	£	s.	d.	£	s.	d.
By Buildings, Fixtures and Fittings	712	10	10			
Less 5 per cent. depreciation	35	12	6			
				676	18	4
STOCK				1,772	12	1
Sundry Debtors	8,098	13	11½			
Less Bad Debts Reserve ...	100	0	0			
				7,998	13	11½
Shares A.W.S.		10	0			
Shares C.W.S.	146	18	4			
				147	8	4
Cash in Hand				504	13	1
				£11,100	5	9½

TRADING AND PROFIT AND LOSS ACCOUNT.

	£	s.	d.
To Stock at start	870	16	1
Purchases, less Returns and Allowances ...	30,179	17	3
Carriage and Haulage	1,208	11	4
Gross Profit carried down	2,158	18	4
	£34,418	3	0

	£	s.	d.
By Sales	32,645	10	11
Stock at close	1,772	12	1
	£34,418	3	0

	£	s.	d.
To Salaries and Wages	424	13	0
Rent, Rates, Insurance and Audit Fees ...	81	19	0
Bank Charges	133	11	6
Sack Charges Returns, Discounts, Allowances, Grinding, Stamps, Stationery, Printing and General Expenses ...	781	4	1½
Profit for Year, to Profit and Loss Appropriation	938	8	5½
	£2.359	16	1

	£	s.	d.
Gross Profit brought down	2,158	18	4
Discounts Received	200	17	9
	£2,359	16	1

While there is nothing at all unusual or exceptional in a gross margin of six and a half per cent. on the sales, yet great things are possible with it, provided that (*a*) the working costs are kept low, (*b*) the capital turnover is high, and it is largely in these directions that we must look for the factors which have made for the society's success.

Working Costs.—An examination of the accounts of the society shows that while during the seventeen years, the turnover has increased thirty-two fold (from £1,027 to £32,645), the total working costs have increased twenty fold (from £72 to £1,421), and the total bill for wages and salaries has increased ninefold (from £45 to £425), the relative rates of increase of these three have been plotted in Fig. 1.

There is no doubt that the financial success of the society is largely due to the fact, that, with a rapidly increasing turnover, the working costs and standing charges have not increased proportionally. This can be seen from Table III:—

TABLE III.—WORKING COSTS.

Year.	Total. £	s.	d.	As per cent. of Gross Sales.	As per cent. of Gross Margin.
1908	71	12	7	6.9	—
1909	147	15	11	8.0	1,117
1910	337	11	11	13.7	114
1911	281	19	5	9.9	148
1912	396	2	9	9.4	80
1913	498	19	8	9.2	98
1914	634	18	10	10.5	86
1915	866	17	8	9.2	82
1916	529	16	9	4.3	55
1917	535	3	6	3.5	60
1918	613	15	9	4.3	67
1919	602	7	0	3.5	66
1920	908	8	11	3.3	87
1921	1,447	19	3	5.1	52
1922	1.220	7	2	5.1	62
1923	1,104	13	11	4.2	76
1924	1,421	7	7	4.4	66

TABLE IV.

	8 Years. 1908-1915. £	s.	d.	9 Years. 1916-1924. £	s.	d.	17 Years. 1908-1924. £	s.	d.
Total Sales	33,080	6	6½	198,044	4	4	231,124	10	10½
Gross Margin	2,746	14	0½	12,949	9	2	15,696	3	2½
Net Profit	141	7	7½	6,386	3	6	6,527	11	1½
Working Costs	2,605	6	5	6,563	5	8	9,168	12	1

Gross margin as percentage of Sales	8.3 per cent.	6.5 per cent.	6.6 per cent.
Working Costs as percentage of Sales ...	7.9 ,,	3.3 ,,	3.8 ,,
Net Profit as percentage of Sales	0.4 ,,	3.2 ,,	2.8 ,,

From Table IV it will be seen that while during the first period, the working margin between the selling and buying price corresponded to 8.3 per cent. of the turnover, yet owing to the relatively high working costs on limited sales, the actual net profit worked out at only 0.4 per cent. on the turnover. During the second period, with a working gross margin of only 6.5 per cent., the net profit corresponded to 3.2 per cent.

In looking closely into the financial records of the society, one cannot but be struck by the remarkably low labour and management costs, particularly when these are viewed in the light of what that labour is doing in return. In 1908, the wages bill absorbed 4.3 per cent. of the gross sales, in 1924 only 1.3 per cent. In the early days of the society, more than 40 per cent. of the gross margin was utilised in the payment of the wages bill; last year less than 20 per cent. was so used.

The information available in the balance sheets and trading accounts makes it possible to subdivide the working costs into three sections:—

a. The labour and management charges.

b. Interest and Bank charges.

c. Sundry expenses, including depreciation of plant, buildings and equipment.

The Bank charges have steadily increased from £8 12s. 3d. in 1908 to £133 11s. 6d. in 1924, but throughout the whole period, have remained a fairly constant proportion, roughly 10 per cent., of the total working costs.

On the other hand, the proportion of the working costs attributable to labour, has been steadily decreasing, while the proportion payable to sundries and depreciation are similarly increasing.

TABLE V.—WORKING COSTS.

	1908.			1924.		
	£	s.	d.	£	s.	d.
Bank Charges	8	12	3	133	11	6
Labour Charges...	45	0	0	424	13	0
Sundries including Depreciation	18	0	4	863	3	1
Total Working Costs	£71	12	7	£1,421	7	7
Bank Charges as percentage of Total ...	12.0 per cent.			9.4 per cent.		
Labour Charges ,, ,, ...	62.8 ,,			29.9 ,,		
Sundries ,, ,, ...	25.2 ,,			60.7 ,,		

Undoubtedly, therefore, one of the principal reasons for the phenomenal success of the society has been its *low working costs,*

averaging throughout the whole period only 3.8 per cent. of the turnover, and particularly the *low labour and management costs*, which during the last year amounted to only 1.3 per cent. of the turnover, or to less than 20 per cent. of the gross margin.

Net Profit.—Actually, the net profit, as can be seen in Table IV has averaged, throughout the whole seventeen years, only 2.8 per cent. on the total turnover. A profit of 2¾ per cent. on the turnover would not be much, provided the capital invested were turned over only once each year, but if only the capital can be turned over indefinitely, the profit expressed as a per cent. of the capital actually invested may become almost ridiculously large.

One of the difficulties under which the agriculturist must always labour, is the comparative smallness of his capital turnover, due largely to the fact that as a rule he can have for sale from each unit of land, only one crop a year, and also that from the nature of his calling, he must be carrying a large proportion of dead and non-productive capital. The draper, turning over his capital four or five times a year, goes in for small profits and quick returns. The butcher, turning over his capital approximately once a week, certainly gets his quick returns, though his profits are not necessarily small.

In 1908, the 77 members who founded the society invested in it a share capital paid up of £48 7s. 6d., in that year the total sales amounted to 21 times the share capital paid up. In 1924, the 121 members of the society had actually paid in only £94 17s. 6d., as share capital, yet the total sales amounted to 342 times that share capital.

TABLE VI.

Year.	Share Capital paid in by Members.	Bonus Capital.	Accumulated Profits.	Total Owned Capital.	Total Sales.	No. of times the owned capital was turned over.
	£	£	£	£	£	
1908	48	–	–	48	1,028	21
1909	49	–	–	49	1,853	38
1910	51	–	–	51	2,455	48
1911	51	–	–	51	2,627	51
1912	51	–	1	52	4,231	82
1913	51	–	4	55	5,418	99
1914	51	–	101	156	6,021	38
1915	51	–	261	312	9,449	30
1916	56	–	680	736	12,458	17
1917	67	–	1,187	1,254	15,208	12
1918	74	–	1,573	1,647	14,687	9
1919	75	–	1,939	2,014	16,975	8½
1920	80	–	2,410	2,490	27,629	11
1921	82	–	3,987	4,069	28,340	7
1922	84	–	4,946	5,030	23,951	5
1923	92	1,100	4,618	5,810	26,102	4½
1924	95	1,100	5,471	6,666	32,646	5

With the low working costs already referred to, and the enormous capital turnover, there need be little surprise at the very favourable financial returns which have been obtained on the capital invested by the members in the business.

How has the Society been Financed?—One may well wonder how a business of this kind has been financed when only £94 17s. 6d. has been put into it by the members, and the turnover now amounts to more than £32,000 a year (Fig. 2).

As in the case of a very large number of requisite societies in Wales, it has been financed to a very large extent by accumulated profits. During the seventeen years of its existence, a total net profit has been made of well over £6,500, not a penny of which has been taken out by the members in the form of bonus, though in 1923, £1,100 was transferred to them in the form of bonus share capital, on which apparently no interest has, as yet, been paid. On 31st December, 1924, the total assets of the society amounted to £11,100 5s. 9½d., as follows:—

TABLE VII.

	Total.			Per Member.			Per cent.
	£	s.	d.	£	s.	d.	
Share Capital actually paid ...	94	17	6	0	15	6	0.9
Bonus Capital	1,100	0	0	9	1	9	9.9
Bank Overdraft	1,652	18	0	13	13	0	14.9
Trade Creditors	2,781	19	0	23	0	0	25.1
Accumulated Profits	5,470	11	3½	45	4	9	49.2
TOTAL ...	11,100	5	9½	91	15	0	100.0

While one can hardly question the soundness of the system and the efficiency of the management which has enabled a co-operative venture with a yearly turnover of £32,000 to be financed to the extent of nearly 60 per cent. out of accumulated profits, yet one cannot but confess to a feeling of disappointment that after seventeen years successful working the society should still be struggling along with an adverse bank balance of £1,652 18s., or one of £13 13s. per member, and still be in the unhappy position of being in arrears to the extent of £2,781 19s., or £23 per member, in payment for the goods supplied to them. This becomes all the more disappointing when it is seen that the society, being at least five weeks behind, is losing all the advantage of the discounts allowed for prompt payment for supplies.

Where is the Capital Invested?—The reason for this apparent paradox can readily be understood from a study of the

assets of the society, which on 31st December, 1924, were made up as follows (Fig. 3):—

TABLE VIII.

	Total. £	s.	d.	Per Member. £	s.	d.	Per cent.
Credit given to Members ...	7,998	13	11½	66	5	10	72
Stock in Trade	1,772	12	1	14	13	0	16
Buildings and Equipment ...	676	18	4	5	8	5	6
Cash and Liquid Assets ...	504	13	1	4	3	5	5
Investments	147	8	4	1	4	4	1
TOTAL ...	£11,100	5	9½	£91	15	0	100

The fact that credit to the extent of £66 5s. 10d. per member is being given may possibly have something to be said in its favour, particularly in a district like this, but undoubtedly there is much that could be said against it.

With members roughly three months behind with their payments, money has to be found elsewhere, and bank overdrafts with their accompanying bank charges become necessary; funds are not available for prompt payment of the goods bought for sale to the members, and the usual discounts are lost; the accumulated profits amounting to £5,470, which might have been distributed amongst the members are now wanted to finance the business.

Actually the Society is paying cash within *six weeks* for its purchases, and getting paid cash within *three months* for its sales, and this means that in addition to the society losing its discounts, the members are losing their bonus, or, at all events, are unable to touch it.

It is interesting to find that, as in the case of so many Welsh societies, so small a proportion of the assets are invested in bricks and mortar—a total of only £676 18s. 4d., or less than 6 per cent. This undoubtedly is one of the contributory causes of the high capital turnover.

In conclusion the following questions and answers may not be without interest and significance:—

1. *What have the Members given to the Society?*
   a. £94, or 15s. 6d. per head.
   b. Loyalty.
2. *What has the Society given to the Members?*
   a. Credit to the extent of £52,589 17s. 2d. for 83 days, free of interest.
   b. Bonus Shares of £1,100, which as yet have borne no interest.

c. A return of 500 per cent. on the Share Capital actually paid in, not one penny of which, however, has as yet found its way into their pockets.

3. *What would the Society give to its Members in case of its liquidation?*

	£
a. Share Capital paid in by members	94
b. Bonus Capital distributed to members ...	1,100
c. Accumulated Profits now required in business...	5,470
A total of	£6,664

or of £55 2s. per member.

4. *What have the Management and Staff given to the Society?*
   a. Efficient service and devotion to duty.

5. *What has the Society given to the Management and Staff?*
   a. Office and storage accommodation up to 1923, decidedly crowded and uncomfortable.
   b. A total wage bill last year of £424 13s., corresponding to little more than 1 per cent. of the gross turnover; less than 20 per cent. of the gross margin, and corresponding to an average wage bill of approximately £2 each per week.

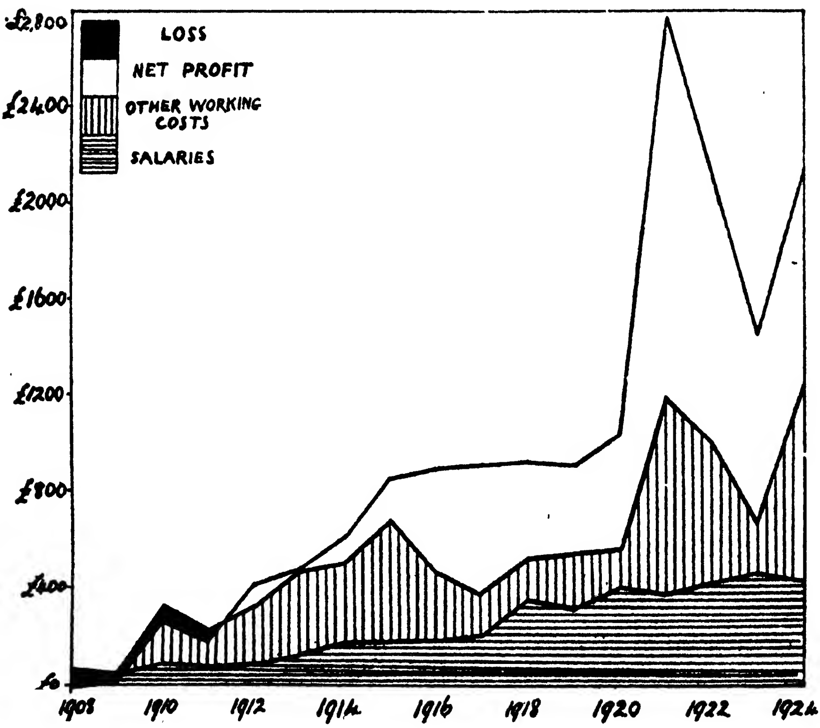

FIG. 4.—Showing Profit, Loss, Working Costs and Salaries.

The questions too which one feels ought to be put and possibly left unanswered are :—1. Have the members *given* too little? and 2. Have the management and staff *received* too little of the fruits of the success which their labours have made possible? One would also like to have an opportunity of calling to the attention of the management the methods which have been adopted with success by a well-known English society to encourage more prompt payment from its members. The general terms of payment in this society are *cash within fourteen days*, and only those members' purchases which are paid for within fourteen days qualify for bonus.

While possibly this may have had the effect of limiting sales, it has left the society in a strong financial position, and it is interesting to note that out of total sales last year of £65,244, no less than £44,000 qualified for bonus.

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THE GROWING OF LUCERNE.

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DURING the latter part of 1925 and the beginning of the present year a series of conferences on matters of agricultural interest have been held at Rothamsted. They have been attended by farmers, scientific workers, and representatives of the fertiliser and seed trades, and have produced frank and many-sided discussions of the problems raised.

The subjects already considered have included green manuring, liming, and the manuring of potatoes, the last of which was dealt with quite fully in the January issue of this *Journal.* A further conference on the growing of lucerne was held on 27th January last, and it is proposed to give here a short summary of the proceedings.

Lord Clinton, the Chairman of the Lawes Agricultural Trust Committee, when opening the conference, first laid stress upon the admitted success of the previous conferences, and upon the great importance of the lucerne crop in the agriculture of the world.

He further called attention to its national importance as a crop which might form a valuable part of systems of husbandry which would support an adequate population on the land. An extension of the area upon which the crop can be grown successfully in this country is a matter of the greatest importance, and

the results of certain work carried out by Rothamsted at a number of centres scattered over the country, suggest that a great extension may be possible.

Sir John Russell, in an address on the history and position of the crop, here and elsewhere, gave a succinct account of the lucerne problems confronting our agriculture. He said that he had been very greatly impressed by the rapid spread of lucerne in Canada and the United States. During a recent visit to the other side of the Atlantic he had found that experiments in connection with it were being carried out at nearly all the State and Provincial stations, and that the actual area under it was increasing rapidly.

In Canada in 1909 there were 57,000 acres of lucerne while in 1924 there were 400,000 acres. In the United States the increase has been even more remarkable, for while the area was 2,000,000 acres in 1900, it had been increased to 10,500,000 in 1924.

After close observation and due consideration he had come to the conclusion that this great increase of popularity is due to the fact that lucerne is an excellent crop to grow either where labour is dear or where it is desired to bring additional fertility to the soil to enable it to support systems of more intensive farming.

Turning to the history of lucerne in England he said that it was imported from the Continent some 300 years ago, about the same time as clover, but whereas the latter has spread all over the country the lucerne has remained more or less confined in those south-eastern counties which first received it. Both clover and lucerne are plants which live in symbiosis with nitrogen-collecting organisms on their roots. The organism suited to the red clover is thought to be present in most of our soils, while that special to lucerne is not, and he suggested that this fact may help to account for the difference in the history and distribution of the two crops. The work centred on Rothamsted has been concerned, so far, with the problem of supplying the necessary organisms to the lucerne in a quantity and form which would make possible the growing of a vigorous crop, even where the important bacillus is naturally absent.

The present problems connected with the crop and the possible extension of its area in this country, can be classified under these heads :—

(1) Problems of the Organism.
(2) Problems of the Plant and of Manuring.
(3) Problems of Cultivation and Soil Management.

The lucerne work at Rothamsted and its outside centres has been made possible by the grant of funds by the Royal Agricultural Society of England, which body is therefore closely identified with any progress that may be made.

Problems of the Organism.—A history of the Rothamsted work on seed inoculation was given by Mr. H. G. Thornton, who is in charge of it. The idea of seed and soil inoculation arose from the work of Nobbe and Hiltner in Germany during the 'nineties of the last century. Many of the earlier efforts failed through faulty technique in the laboratory and the field, and through the use of unsuitable crops. In recent years considerable advances have been made in the growth and keeping of cultures in the laboratory. For instance, Barthel in Sweden has shown that cultures grown in sterilised soil keep longer than others, and stock cultures are now grown in this way.

The cultures are generally issued for use on a special (agar jelly) medium and the constitution of this has been found to be important. An extract of lucerne root used in the medium hastens the growth of the culture very materially and so increases its virulence. Cultures on this special medium are sent out to farmers and when required for use are put into milk, and the milk-bacillus mixture is used for wetting the seed before sowing.

For inoculation it is important that a high percentage of the organisms shall be in a form capable of movement in the soil, and it has been found that the addition of phosphate to the milk medium greatly increases their speed in passing through soil.

In the matter of the prevalence of the lucerne organism in our soils it is considered certain that it is present in many of those of the south-eastern counties where the crop is common, but that it is largely absent elsewhere. It is thought that as far as the provision of the organism is concerned, the knowledge now available should enable a considerable extension to be made in the acreage of the crop in this country.

The Rothamsted work, generously supported by the Royal Agricultural Society of England and by many outside growers who give time and labour to it, is being carried out on a uniform plan at over 50 centres in Great Britain. The results already obtained show wide differences in the effects of inoculation under varying conditions. Increases of crop of the following

orders have been obtained with inoculated seed in various parts of the country:—

Gloucestershire	179 per cent. increase	Cornwall	31 per cent. increase
Wiltshire	141 " "	Durham	16.8 " "
Kincardine	40 " "	Staffordshire	2 " "
Warwickshire	35 " "		

In addition to increases of gross yield an increase in the nitrogen-content of the herbage is often found in inoculated crops, and this must be taken into account when estimating the value of the fodder produced.

There are records from Scotland and elsewhere of good yields of lucerne produced on land which was thought to be strange to the crop, without the aid of seed or soil inoculation, and there are many accounts of failures with inoculated crops in various parts of the country. An adequate supply of lime in the soil and the absence of stagnant water seem to be essential conditions for the joint prosperity of the organism and the crop.

Problems of the Plant and of Manuring.—The points for discussion under this head divide themselves into two groups (1) those connected with the selection and use of suitable strains of lucerne, and (2) those which have to do with the nutrition of the plant.

Types.—As was pointed out by Mr. Williams of the Welsh Plant Breeding Station at Aberystwyth each so-called variety or strain of lucerne consists of a mass of mixed individual types, which often show more difference among themselves than exists between definitely named strains. All the plants are hybrids which breed on in a completely irregular manner, and it is not possible to obtain definite improvement of type by the ordinary methods of selection. Lucerne can be self-pollinated and where this is done for a number of generations some fixity of type can be obtained, while the vigour lost in such a proceeding can be regained by crosses between the selected types. By proceeding in this manner there is a chance that new and improved types of lucerne may be produced suited to various conditions of soil, situation and climate.

In the meanwhile a distinction between seed on a nationality or district basis is found, and a great number of trials have been carried out in the past with lucernes hailing from various parts of the globe. At the present time trials are in progress under the auspices of the National Institute of Agricultural Botany with Provence, English, Grimm, Peruvian, Kansas, Dakota, Cape Provence and Hungarian strains of seed. It is generally

supposed that Grimm and Hungarian strains are particularly hardly and well suited for use in the colder parts of the country, and in more exposed situations.

In one set of trials carried out by Messrs. Gartons, Ltd., two strains of English-grown seed did better than Provence and Grimm strains. In wet districts Grimm and Canadian variegated are found to do well, largely because their time of maturity tends to correspond with such short periods of haymaking weather as may normally be expected.

Manuring.—In the matter of manuring this crop, wide differences in practice are found on different farms. The use of farmyard manure is deprecated by some farmers as being likely to loosen the soil and destroy the firmness of the seed bed. By others, particularly those working heavy land, it is recommended as an excellent basis upon which to start the crop. No doubt there is full justification for both practices, and the adoption of one or other of them must be decided at the discretion of the farmer in the light of his knowledge of his own land.

Nitrate of soda has been found to be very helpful in encouraging the plant to quick, early growth, and strong establishment. The usefulness of the added nitrate disappears once the number of nodules on the plant roots become large enough to harbour an adequate supply of nitrogen-collecting organisms.

The use of phosphates, largely in the form of superphosphate, has been found beneficial on many soils, notably on those which are known to answer well to it with other rotation crops. Experience from Wales is confirmed by practice in parts of Somerset, where a dressing of 3 to 4 cwt. of superphosphate is considered to be a necessary step in preparation for a crop of lucerne.

Additional potash has been found necessary to the health of the crop on many light soils, and there are definite experimental results from Woburn which show that shortage of potash may result in the complete failure of the crop. Where potash was given, Dr. Voelcker was able to continue lucerne plots for 13 years even without added lime, whereas in its absence plots died out completely after a shorter period.

Lime.—The existence of an adequate supply of lime in the soil appears to be a general requirement of the crop, and the absence of it has been made to account for many records of failure. In wet situations where the soil is much washed a great quantity of lime is lost by leaching, and in such places, and indeed in

all soils where any lime shortage is known to exist, an adequate dressing of quicklime or ground chalk is recommended before the sowing of the lucerne seed. There are many cases, as at Woburn, where the crop has got itself established and has done well despite a lime scarcity, but it is generally considered that an ample lime supply is an important factor in obtaining a satisfactory and safe start for the young plants. When they are well established their root system is large enough to ramify through great areas and depths of soil and to take advantage of lime found there.

Problems of Cultivation and Soil Management.—The group of problems includes most of those things which only the farmer can do to help the crop, and in the solution of them individual skill and judgment are of the greatest importance.

The general consensus of opinion seems to be that lucerne requires a firm, moist seed-bed with a particularly fine surface tilth, and that it is very important that the land be well cleaned before the crop is sown.

In competition with other plants, as in seed mixtures, lucerne does not generally do well, and it may suffer to a very great extent from heavy weed infestation, particularly in the early stages of its growth.

Wet and water-logged land is particularly bad for the crop, and adequate drainage—either natural or artificial—is necessary to its success. When the choice and preparation of the land are satisfactory another whole group of debatable points come up for consideration.

Cover crops may be used or the seed may be sown by itself. The seed may be drilled in hoeable rows or broadcast. Concerning the use of cover crops, there is a good deal of seeming disagreement among growers. In the wetter districts they are recommended on the ground that if a sown cover crop is not used a voluntary one of weeds will appear in place of it. In drier places they are sometimes objected to because they compete with the lucerne plants for the limited supply of available moisture. The actual effects of shading due to the cover crop are variously estimated, but there seems to be a strong tendency to use thin sowings of cereals and to cut the cover crop green, before it has reached its full development. At the Hertfordshire County Institute in 1925 inoculated lucerne was grown very successfully under a heavy cover crop of barley, and the benefit due to inoculation was found to be much greater where the cover crop was used than on adjoining land where the lucerne

was sown without it. A Scandinavian cover crop consisting of a thin seeding of barley and oats is used successfully on Lord Bledisloe's farms in Gloucestershire, while Mr. Christopher Turnor in Lincolnshire has lately used a cereal cover crop with success, although it is his usual custom to sow lucerne by itself.

The date of sowing may vary between April and August. Early sowing of lucerne has certain advantages, for it enables the plant to get well established during its first growing season and before it is tried by winter conditions. On the other hand, July and August sowings give the farmer a better chance of cleaning his land thoroughly, and may allow him to get off another crop before putting in the lucerne. Good results and failures have been obtained equally with both early and late sowings, and no absolute general recommendation can be made in the matter of sowing date.

The choice between drilling and broadcasting opens up the question of after-cultivation and the expected duration of the crop. Whichever is done it is generally agreed that the sowing should be a very shallow one, and that the seed should be covered to a depth not greater than one inch. The balance of opinion and experience seems to favour sowing in wide and hoeable drills, although in three cases reported from Somerset experienced farmers were emphatic in support of broadcasting.

The question of the after-care of the crop includes measures for cleaning it and methods of harvesting. There is general agreement that when it is once well established a lucerne crop can endure the most drastic measures of intercultivation and cleaning without detriment to its future prospects. Horse hoes, culitvators, harrows and skim ploughs can all be used upon it with satisfactory results. Cleaning during the earlier stages of growth is a more difficult business, but much can be done in destroying annual weeds by cutting the crop when it is relatively small and before the weeds that are cut with it have formed seeds. Some objection to cutting lucerne in the young stage is raised on the ground that the cutting off of a single crown shoot before a second one has formed to take up its work may lead to the destruction of the young plant.

Experiments carried out at Reading showed that though hand-hoed specimens did best of a series of cultivation plots, quite considerable benefits accrued from cleaning with harrows alone. The economy of the crop depends to a great degree upon its duration, and this in turn is decided largely by the efficacy of the after-care which it receives.

Uses.—The crop, well established, can be harvested as hay; it can be converted into silage; it can be cut and fed green to stock of various kinds; or it may be grazed upon the land. It may give up to five or six cuts in the year and can be relied upon for two or three in nearly all seasons. Lucerne herbage is extraordinarily nutritious, and is well suited to such stock as dairy cows, which require a considerable supply of protein in their rations. It is not too easy to make into hay, since it dries slowly and heats readily in the stack, while it cannot be moved much in the field without danger of a heavy loss of leaf and therefore of quality.

The fertility added to the soil by the growth of a long lucerne ley is certainly to be regarded as one of the greatest advantages of the crop. It is well illustrated by a case reported by Mr. Christopher Turnor from Lincolnshire where eight successive crops (six of them cereals) were grown without manure after a five years' stand of lucerne. The fifth of these crops was oats, which yielded 9½ quarters to the acre.

NOTE.—The above article is a summary of information and opinions derived from papers read to the Conference by Sir John Russell, Mr. Thornton, Mr. James Mackintosh, Mr. Cunningham, and Mr. Williams, and from remarks made during the discussion by Lord Clinton, Lord Bledisloe, Mr. Christopher Turnor, Mr. Gardner, Mr. Hay, Mr. G. P. Miln, Mr. Dampier Whetham, Mr. J. G. Stewart, Mr. Field, Mr. S. F. Armstrong, Mr. Shipway and Dr. Voelcker.

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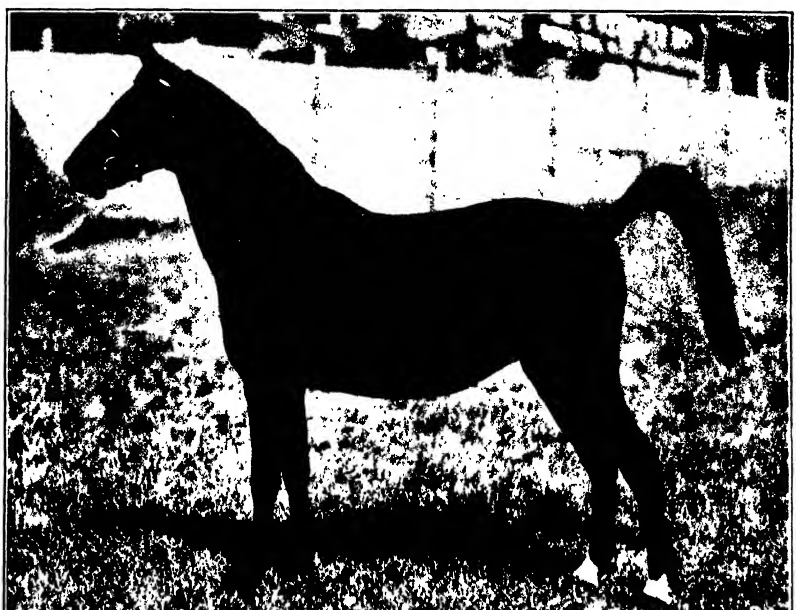
THE WELSH MOUNTAIN PONY.

CAPT. T. A. HOWSON.

THE term "Welsh" pony is a wide and, often, loosely applied one. In its common acceptation it apparently embraces both the Mountain pony proper and (by a fiction that mere incident of birth, apart from lineage, can fix an equine's nationality) anything besides, of pony height, which has been foaled in Wales—regardless of the fact that many of the animals, to which the prefix is applied, have little that is Welsh about them. In this article it is proposed, therefore, to treat only of the mountain pony, which is the rock on which all other Cambrian equine superstructures—cobs and ponies—have been built, and, further, to deal with that pony chiefly from the semi-feral point of view.

Photo] [*London Daily Mail*

FIG. 1.—Welsh Mountain Pony Stallion, Grove King Cole II.



Photo] [*G. H. Parsons*

FIG. 2.—Welsh Mountain Pony Mare, Grove Lady Bird.

[G. Toulmin & Sons, Ltd.—Preston

FIG. 3.—Group of Welsh Mountain Pony Mares and Foals.

Early History.—The precise origin of the Welsh mountain pony can now only be a matter of conjecture. It is probable that both it and several of the other tribes of smaller ponies, indigenous to the United Kingdom, had some common ancestry in an age long past. It is certain that, from immemorial times, the mountains and waste places of Wales have been inhabited by ponies. When Bishop Baldwin made his Itinerary through the Principality in the year A.D. 1188, we are told by his comprehensive chronicler, Gerald the Welshman, that the *hills* of that country were full of "horses." When Howell Dda ruled over Wales, a thousand years or more ago, it is related that he enacted laws regarding the ponies of his Kingdom, and history records that subsequent potentates followed his example.

Not all of these enactments were beneficial to the equine subjects and some were, most distinctly, punitive in their results: in fact, it would appear that until the passing of the Commons Act of 1908, not one amongst them all was, primarily, directed towards the improvement of the animals, regarded as a breed.

For generations the indigenous Welsh pony stock lived a purely vagabond existence: frequently, it was regarded as an unmitigated nuisance—sometimes tolerated, more often not. In the earlier days, the animals had to live as best they could, and, in addition to the general neglect which was perpetually their portion, they suffered from the ever-active persecution of the hill shepherds who, looking upon them as hereditary foes, sought every opportunity to harry them away from any decent patch of grazing ground that they might chance to find.

Considering this early history of the Welsh breed of pony, it is easy to realise that while its mode of life might not conduce towards any marked advancement in bodily perfection, from a structural standpoint, it must have developed in a very material degree that sagacity, tenacity of life, pluck, hardihood and agility for which the Welsh pony has so long been justly famed, and which it has the power of transmitting (to an extent which must be seen to be believed) to any other stock with which it may be crossed. None but the most hardened stock could have survived what the Welsh mountain pony has had to endure in the past; and while natural selection, which inevitably obtained, might not have tended towards the attainment of symmetrical perfection, the very hardships suffered must have tended towards forming and stabilising a certain

crude equality and uniformity of type, automatically safeguarding purity of blood and pony temperament, since only true bred ponies, as opposed to horses, could have borne them: alien blood would have succumbed quickly.

Improvement of the Breed.—In course of time it dawned upon the more observant amongst horsemen that there was, perhaps, something in the Welsh pony which deserved salvation and might possess a value which had previously been overlooked. Gradually, attempts were made to bring about a certain measure of improvement—chiefly through the agency of sporting landowners who tried the experiment of running well-bred sires amongst the mares. One of the earliest records of this which we have was the turning out, in North Wales, of a little blood-horse of the name of Merlin. The results of these experiments would seem to have boded good upon the whole, for, certainly, the practice spread to some extent; but, none the less, it was of a dilatory, intermittent, and even accidental kind. It may be averred that little in the way of systematic or organised attempts to improve the mountain ponies in their feral state was done until the Hill Pony Improvement and Welsh Pony and Cob Societies came into being in recent times.

Curiously enough the pioneer amongst Societies, having as their object the improvement of Welsh Mountain Ponies, was one born in England and it took in hand the care of the, virtually, Welsh ponies roaming on the Longmynd Hills in Shropshire. The plan adopted there was to obtain the co-operation and interest of the owners of the ponies running on the hills; to round the ponies up each year regularly; to cull the weeds and males regarded as unsuitable as sires; and to select and turn out, in the latters' stead, a group of typical and well-bred stallions amongst the various herds of mares.

The good accruing from this practice was soon patent; but the brotherhood of pioneers had, unhappily, one other obstacle to overcome. The Longmynd Hills, like many other pony haunts, are common lands and there was nothing to prevent a commoner of the deliberately obstructive order—a type of whom may be found in every community—from turning out, amongst his neighbour's stock, male animals of alien parentage, or so utterly lacking in merit as tended to nullify any attempt at general betterment.

The current had, however, set in; other improvement societies came into being backed by men who meant to bring the movement to success, although they were worried—but

not, by any means, dismayed—by the spiteful actions of a minority of malcontents. They persevered until, in the end, they triumphed by securing the passing of the Commons Act, which has been rightly dubbed "the native ponies' Magna Charta." In brief, this Commons Act forbids the turning out, on all common lands to which it is applied, of any entires which have not been officially approved. Many districts have now had the good sense to pursue the laudable example set by their Salopian cousins and, to-day, societies exist throughout the length and breadth of Wales—with a national breed society to mother all; the aid of the Commons Act has been invoked; the Government grants premiums to selected sires; landowners as a body look upon improvement schemes with favour and give them their support; and what was once a most chaotic mode of pony breeding has now been reduced to something like an ordered and progressive scheme.

The good which has accrued from concerted, considered and persistent action is observable on every hand. Faults of conformation are being gradually eliminated, a uniform, improved and level type is being standardised and fixed, and (while often better treated in the winter months than in the days of yore) the natural life still led by the animals themselves ensures retention of that hardiness and gameness which must always rank amongst the mountain pony's chief assets.

Dangers there still are, the greatest of which, perhaps, lies in the possibility that outside blood may creep into the native herds through some of the selected sires, unless close attention is paid to purity of lineage as well as to good looks. The Welsh mountain pony has long since attained the status of a well-established and prepotent breed, and the time for introducing any further foreign element has now gone by, whatever might have been the need for doing so in other days. But perhaps the danger hinted at is not a great one, and there is, maybe, little cause to apprehend that common sense will be discarded in this particular.

The Points of the Breed.—In the writer's opinion it is a cardinal point that the Welsh mountain pony should not exceed 12 hands in height. There is an agitation, in some quarters, for the raising of this height to 12.2 but (for many reasons which cannot be detailed here) such agitation should be doggedly opposed. The breed's whole life story quite clearly indicates that its proper height does not exceed 12 hands, and that in the retention of that limit lies its safeguard for the future. How-

ever, " the 'eight of an oss has nothin' to do with his size," as Buckram once impressed on Soapy Sponge, and, while 12 hands should be the mountain pony's utmost limit as to height, it is desirable in every way that, be he 10 to 12 hands high, he shall at all times be a *big* one for his inches.

The head should be small and full of " work " and breeding; the ears quite small, firm and pricked; the eyes bold, full, alert and blazing, with a goodly span of skull between them. The face has frequently a slightly dished and Arab-like appearance—the nostrils being decidedly developed, the muzzle fine, and the jowl somewhat prominent and slightly convex. The throat latch should be well cleaned out, and the whole headpiece elegantly worn upon a lengthy, supple and well carried neck, which frequently attains considerable proportions in developed sires—a feature which is not to be too hastily condemned. The neck should terminate in deep, clean, well laid shoulders—too great stress cannot be placed upon the cultivation of a riding outlook.

The withers should be well defined and should sink into a firm, strong back and powerful loin with a goodly length of croup, ending in a well-developed dock and gaily-carried tail. (Short croups, goose rumps and drooping tails are common failings amongst " wild "-bred native ponies, but must be suppressed.) The ribs are deep, well sprung and round, and it is most essential that the heart and back ribs should show marked development.

The quarters must be neatly turned, deep and square, and well let down and full when looked at from behind. The knees and hocks are big and near the ground; the limbs are short and plentifully endowed with bone; and the hoofs are dense, tough and round. The mane and tail (which are left long) are of fine, silky texture, as also is the hair upon the heels. The soundness of the breed is quite proverbial.

In colour the ponies vary widely. Greys, roans, blacks, bays, browns, chestnuts, creams and duns are common, but piebalds and weird coloured ones are very much disliked, as testifying to a mesalliance somewhere; pronounced white markings and gaudy daubs of white are also looked upon with disfavour.

In action the Welsh mountain pony is unique. Its movement must be free and fiery, with every single joint brought into forceful play. The action must be true in every sense, and must be right away in front and underneath behind. The hocks must be flexed very boldly and the knees well lifted, but without that " up to the elbow " snap distinctive of the Hackney. Individually selective breeding upon stud farm lines and artificial (or semi-artificial) training for the show ring can,

undoubtedly, result in the accentuation of the ponies' action; but mountain pony action, even in accentuated form, should be exaggeration more of riding than of harness action.

Uses of the Mountain Pony.—The thoughtless sceptic often asks what use the small Welsh mountain ponies are. The most elementary knowledge of their history would suffice to make such a query superfluous. For long they have formed, and should ever form, an invaluable reserve of good qualities which can be drawn upon for the benefit of British horses.

As foundation stock their value is willingly conceded by all those who have devoted, or devote, the smallest thought to light horse breeding. Their blood is to be traced in countless horses not by any means without renown upon the turf, both over jumps and on the flat. Myriads of the gamest hunters which have ever crossed a country owe not a little of their cleverness and their endurance to this pony strain. The Hackney and the Polo pony are indebted to the native sources in a measure which can never be repaid, as are Welsh (and other) cobs and those Welsh ponies, of all classes, which exceed 12 hands in height—to make no mention of a perfect swarm of charming hacks and exhibition riding ponies of all sizes.

Of accomplished horsemen, and horsewomen too, many would be willing to confess that they owed much of their skill and love of horseflesh to their infantile associations with Welsh mountain ponies. The breed provides, perhaps, the finest of all children's mounts, and any animals which hold out promise of attaining show ring eminence (in saddle, hand or harness) are eagerly bought up, at fancy prices, for retention in this country's studs or for export abroad.

Coming to the more prosaic and mundane spheres the coal pits take heavy toll of mountain ponies, and mainly from the ranks of those bred on the hills; while only people who have used them can appreciate the excellent *work* these ponies will do. In comparison with draught animals of much greater size their perseverance and strength are astonishing.

The production, upon lowland stud farms, of Welsh mountain ponies for the show yard has become a vogue, and many animals so bred have been brought to a very high pitch of perfection. There are some who foresee a danger to the race at large in this stud-farm breeding, but, happily, the great majority of owners of the lowland studs are people well acquainted with the history and inborn virtues of their stock, and are, as yet, far from being faddists. So long as the semi-artificially bred ponies are

produced upon ... their type and temperament and purity of blood, and, now and then, recourse is had to necessary fresh infusions from the hills, the practice of so breeding them would seem to be one fraught with little real danger to the wider and more important interests of the breed at large. Fluctuating "fashion" is the enemy to be repelled.

There is now a growing tendency towards providing harness classes for Welsh mountain ponies at the shows. Here again some, whose views demand profound respect, foresee a danger. But so long as all the vital features of the breed are kept continually in view; so long as meritorious shoulders and forehands are looked upon by judges as of priceless worth; so long as exaggerated and spasmodic Hackney action is ruled entirely out of court; and the 12 hands limit—greatest safety valve of all—is never raised; it is not easy to understand why harness classes should work any ill. The more outlets which one has for any breed of stock (and especially for its mediocrities) the better for that breed; and it must never be forgotten that the most important role of the mountain pony is (and ever has been) that of a great provider of foundation stock, a race unrivalled for the evolution not only of riding and driving types, but also of pre-eminently useful dual-purpose animals.

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A COMPARISON OF SCANDINAVIAN AND BRITISH PIG BREEDING METHODS.

III.—CRITICISM OF METHODS AND SUGGESTED IMPROVEMENTS.

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British Methods.—In Scandinavia, practically the only market for pig flesh is the bacon factory, and only one breed is really prominent in each country; the Landrace in Denmark and the Large White Yorkshire in Sweden. In this country on the contrary there is considerable competition for fat pigs between the claims of the bacon curer and the pork butcher, and to supply the requirements of these two markets there are pure-bred pigs of some dozen or more breeds, and a large number of mongrels.

Equally with farmers of other countries, the feeders of pigs in Great Britain realise that, while a cross-bred pig may possibly make a good enough carcass, it is risking trouble to

continue breeding mongrels together too long. Most breeders and feeders of commercial pigs try, therefore, to overcome this difficulty by buying in, occasionally, a boar or a sow from an improved herd which has been pure-bred for some considerable time.

Breed Societies.—The greater part of the improvement carried out in this country is organised through the individual breed societies, which mostly work independently of one another. Each society records the pedigree of all the selected offspring from parents already registered as pure-bred. The herd book, which is the main production of the society, is merely a record of ancestry, and no form of advanced register has yet been employed. There is, in fact, a tendency to work in the opposite direction, because the breed societies compete with one another for the largest number of members.

This has led in the last few years to a marked increase in pedigree herds without any very fixed method of controlling the quality of this new stock. For this reason the influence of breed society development on high quality stock has tended to be of a dispersive, rather than a selective nature.

The only method of controlling the quality within the society is to put a premium on stock of a certain type and so induce members to breed to that type and discard any variation from it. Large prizes are given annually for stock which, according to the societies' experienced judges, conform to the requirements which have been set as the standard. In practice, unfortunately, two very serious difficulties interfere with the value of this method of selection.

Insufficient Control of Pedigree Pigs.—In the first place, this method of control is an arbitrary one, because, while it may encourage the breeder to produce the required standard, there is no effective control of the other, and poorer, quality pigs which have been produced at the same time as the good ones. Unfortunately there is always someone sufficiently inexperienced to pay a high price for any kind of pig provided that its pedigree is registered. By this means a large number of poor quality animals has been distributed.

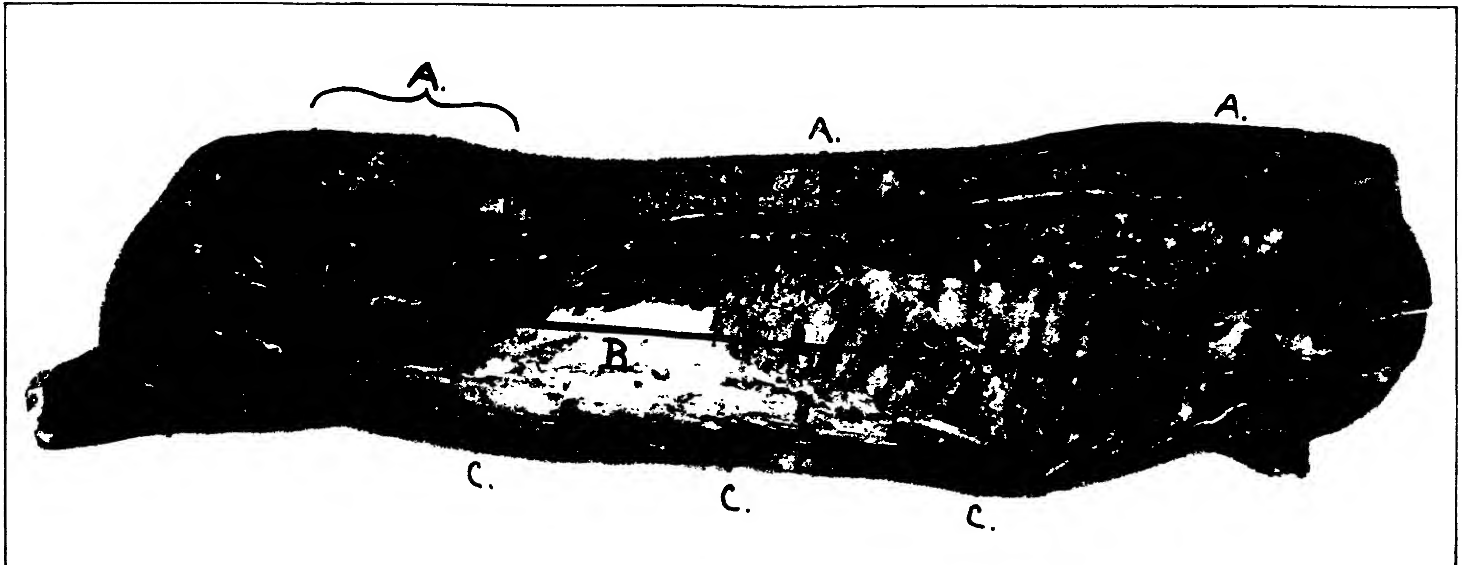
Standard of Excellence.—Secondly, and of greater importance, there is the fact that the standard employed for selection has been an unsound one both from the practical and from the scientific point of view. All pedigree pigs, at present, either for the purpose of selection by the owner for breeding purposes or by the judges for prizes are judged on the so-called " stan-

dard of excellence." The standard of excellence has several objections from a scientific point of view. First of all, it is not a true standard, inasmuch as it is not stated in terms of precision. The terms commonly used are such words as "long," "wide," "deep," etc., and it is quite possible to draw an absurd caricature of a pig which agrees with each and every definition, but which is obviously unlike any animal ever seen.

As it is obvious, however, that the use of a standard has been employed with very great success by many highly successful breeders, and that some British strains of pigs have been evolved by its use which are second to none in the world, it is interesting to see how far the standard of the expert breeder can be compared to the official "standard of excellence" of the breed society. The expert British pig breeder in selecting breeding stock does so on a basis of conformation and he knows that the type he wants has a definite proportion between length and breadth which his highly-trained eye can measure, although in ninety-nine cases out of a hundred he could not tell one how many inches of length and breadth were required. Nevertheless there is a mathematical relation in his mind though he cannot express it numerically. A real standard does exist, so far as it can be exact within the limits of human error as compared with precise measurements, or, rather, one ought to say that a large number of good but different standards do exist. This real standard, however, is not defined at all in the official "standard."

Next, the standards used are estimated by eye judgment alone, a method of procedure which in most other industries is now considered obsolete, and which modern methods of accountancy have swept away from many forms of business. The third objection is that the standard is applied to the breeding animal itself and not to its offspring. Since the recent development of mendelism, it has been shown that it is only in a definite and not very large proportion that "like breeds like," and the only method of discovering under what conditions this is so is the breeding test.

Danish Methods.—Having formulated the above criticisms of British methods, after studying how far they were in line with modern scientific knowledge, and to conform with which other countries are altering or developing their methods—an example that a few authorities in this country would like to



Photo] [*W. Tams*
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FIG. 1.—Stout side of Bacon showing where measurements of length and thickness are taken at the Scandinavian Pig Testing Station.

copy—the systems followed in Scandinavia, and briefly analysed in the two preceding articles, may now be considered. It is of interest to note that they are open to as severe a criticism as the system obtaining in this country.

Of the two Scandinavian countries, Denmark appears to be much the more efficient, and this is due chiefly to the unity of her methods. The Breeding Centres as starting point, backed up by the production records from the private registers and the reports of the Testing Stations, supply information which enables a select list of commercially highly-efficient breeding pigs to be compiled and published in the National Herd Book. These four branches all combine to form an efficient unit of organisation, with the result that there is obtained an advanced register of the cream of the country's breeding stock. By the official recognition given, and subsidies donated at shows, this one type is kept before the farming public and in actual practice does form the nucleus of the country's commercial pigs.

The whole scheme, in so far as it is in practical agreement with genetics, is scientifically sound. So far as the farmer and bacon curer are concerned it is also commercially sound. It has to be remembered that the Dane has been fortunate in having a universal dairy industry as foundation for his pig keeping, that for all practical purposes he has only had one breed to deal with, that he has only had one market to supply (bacon), and that he had a wide co-operative system on which to graft an organisation. Nevertheless, the system of pig improvement employed, and which 40 years ago had to deal with a pig much less suited to the bacon trade than our own at that time, has proved highly efficient in practice and is a great credit to the country.

It has to be admitted, however, that in view of recent investigations in animal husbandry, the Danish model is open to considerable criticism, mainly in connection with the use made of the results from the Testing Stations.

It is difficult to understand on what basis it was decided to test only four pigs from each litter. The connection between the average of four piglings and the average of the whole litter does not appear to have been worked out. Although two pigs of each sex should be tested together, one finds from the reports that quite often the group of four is composed of three of one sex and one of the other. There is no indication of the correction for sex having been worked out. Further, no attention is paid to whether the pen is from the first litter of a pig

or from a later one and no attempt is made to determine the experimental error of each result.

No checks have yet been applied to determine whether the second litter of the same parents would give the same result as the first, and no effort has yet been made to correlate the economic importance of efficiency of food utilisation and quality of carcass so as to arrive at a combined index of value for the whole pig. An investigation of the necessary corrections to be made for all these variations, similar to the work recently done by Hammond and Saunders on milk records, would be of great value.

In general the work done at what the Danes call their experimental stations is really not experimental in the scientific sense and consists merely in applying such ordinary mathematical accuracy to the business of pig breeding as any commercial firm would expect from its staff of clerks. The farmers accept the figures at their face value, without thinking much about the corrections we have suggested, but though, scientifically, this may be unsound it is a big step in the right direction that they should be encouraged to look for commercial points and for reasonably accurate means of determining these points.

Swedish Methods.—Sweden is less fortunate than Denmark because neither the land nor the farming conditions are of one uniform type. As it has decided on the Large White Yorkshire as the most suitable breed it is more concerned to continue importing fresh stock from Great Britain than to concentrate entirely on internal methods of improvement. There also appears to be an impression that though the Danish method is a sound one it may not be wise to adopt it entirely without trying to evolve something even better. British methods and standards have also been followed to a certain extent in connection with the use of a British breed.

For these reasons Swedish pig breeding methods present a much less united appearance than the Danish, and are correspondingly less efficient as a whole. No one method appears to be fixed, and very little use is made of advanced registry. The best points appear to be the encouragement of a large number of moderately good pigs by the subsidising of the boar societies, though the scale of points for diploma sows and especially for prize boars is very arbitrary and without scientific foundation; the encouragement of good buildings and sound methods of management; and above all the institution

of percentage prizes rather than competitive ones, which tends to improve the general level of pig breeding throughout the country rather than to produce a small select number of breeders who have a monopoly of the highest awards.

The last point of interest is the attempt to discover a simple means of testing the breeding capacity of sows without the expense and complication of sending pigs to a central testing station. On account of the possibility of obtaining a much larger number of results than can be obtained from the moderate number of pigs selected to be sent to the testing stations this procedure will be watched in this country with very considerable interest. Since the previous article was written further reports show that the number of herds being tested in this way is increasing fairly rapidly, and it is now possible to make some preliminary analyses of results, though of necessity they will require confirmation. But in spite of the value of the method it must be realised that, although popularity and greater numbers may be obtained, there will be a corresponding sacrifice of accuracy, for it is impossible to ensure that the feeding and general management, on which numbers and weight of litter also depend, will be the same for each herd.

It is true that the same might be said of milk records in this country, but it is now coming to be realised that the "corrected" yield of a cow is a much more valuable figure for comparison than the bald statement of total yield.

Possible Modification of British Methods.—If any modification of the present system in this country were thought of, it would have to be realised that the private breed societies occupy such an important position that they would have to remain as such and be utilised in the new scheme. In the absence of support from co-operative agricultural societies, through which so much has been done in Denmark, help might be obtained from the institutions representing the farmers in this country, such as the Royal Agricultural Society of England, the National Farmers' Union and local chambers of agriculture. It must also be remembered that we have to meet foreign competition in fresh pork as well as in bacon. Bearing these provisos in mind it is suggested that the following steps would materially assist the improvement of the bulk of pigs in this country, and eventually lead to a lowering of the cost of bacon and pork-production, which is the only non-political way in which scientific agriculture can assist the country to meet foreign competition.

Amalgamation of Breed Societies.—A reduction in the large number of breeds in the country would seem to be practically impossible, although it might be demonstrated by figures that only one or two are economically profitable. One very necessary step is the amalgamation of the present breed society organisations. Each society would keep its own headquarters and look after its finances separately, but a central body would be established to co-ordinate the work of the constituent societies. The first improvement that this would bring about would be the standardisation of record keeping and of herd book publication.

Such a central council would organise the keeping of detailed private registers in all pedigree breeds, and the individual breed societies would arrange for trained live-stock officers to check such books and keep an eye on the health and descriptions of animals. Particulars, either full or abstracted, of these registers would be kept at the breed headquarters and all information would be classified in the same way. The breed society would submit to the council such pigs as it thought suitable for admission to the combined advanced register and such application for entry would have to pass a selection committee selecting according to a detailed and scientifically sound standard. The advanced register would in time come to enrol only such pigs as had been proved to be thoroughly suitable for the two markets found in this country, and the elimination of unsuitable breeds would slowly but surely take place through this natural selection, provided any one breed were proved to be really unsuitable.

The advantage of this amalgamation would be that the best methods would be used and the finest machinery employed. Speaking at the Scottish Cattle Breeding Conference at Edinburgh in July, 1924, Dr. L. J. Cole, Chief of the Animal Husbandry Division of the U.S. Bureau of Animal Industry, made the suggestion that it might be of mutual value to animal research workers and breed society secretaries to arrange that far more details of breeding and pedigrees were kept so that they could be examined very thoroughly from a statistical point of view. As the normal compilation of the somewhat meagre information required at present is almost more than some office staffs can tackle, he suggested the use of mechanical sorting and tabulator-printing machines such as are used in actuarial work in life assurance offices and in many other businesses in America and this country. By means of these machines,

which are naturally very costly, an immense amount of detail can be sorted, tabulated, printed and filed all by the work of one or two assistants. A central organisation could easily afford the expense and would soon gain sufficient experience to master a very great deal of information.

Institution of Testing Stations.—The Danish testing station is so sound scientifically and has worked so well that it is difficult to see how some modified and improved form could be done without under a general reorganisation. As the pigs pay for their keep the expense of supervision and recording should not be very high, and the assistance gained by the pig breeders from the bacon curers and pork butchers who would have to hold prominent places on the managing committee of the stations would be all to the good. It may be difficult at first to induce breeders to take advantage of the Station, but it is certain that after a number of years the natural interest in the results would be sufficient inducement to breeders to make use of the tests. Presumably one station or group of stations would confine its attention to pork and would be situated close to a large pork market, *e.g.*, London, and the others would be near some old-established and well recognised bacon factory. The testing station would be a common meeting ground for breeder and curer or butcher.

Central Testing Station Research and Advisory Authority.—If, however, such testing stations are developed, I believe that the lesson from Denmark demonstrates the vital importance of studying the *methods* of animal testing in all their bearings. It has recently been shown that the commonly used methods of testing and comparing the yields of cereals are almost hopelessly inadequate, and that the trained plant breeder, before he can compare the genetic yielding capacity of different varieties, has to study and evolve a satisfactory technique—which, in itself, is a difficult enough problem to employ a large group of investigators.

Some of the factors which interfere with the accuracy of animal testing and the kind of corrections which it is advisable to study and apply have already been mentioned, but too much emphasis cannot be placed on the necessity of studying the methods of testing so that the work which is carried out for the practical information of breeders, can be interpreted in its proper way. Such a central research and advisory authority would confine its attentions entirely to testing methods and would undertake no other research work of any kind. Its staff

should include a highly trained animal statistician and some members who had practical knowledge of bacon and pork. It would work in closest collaboration with the testing station and with the clerical staff of the central council of breed societies, but should be established in close touch with some recognised institute for research in animal husbandry.

Advanced registry of farm animals is at present, and may remain for a long time, highly empirical, but a testing station research authority might make it an extremely accurate and even exact science if it were supported and properly staffed. Certain general information obtained from pigs, which breed more quickly than other farm animals, might in time be applied to sheep and cattle.

Encouragement of Percentage Prizes.—In view of the value of non-competitive prizes for all exhibits attaining over a given percentage of marks, it would appear to be desirable that such prizes or subsidies to be given by the State and the breed societies and other interested authorities at the agricultural shows throughout the country. Above all, however, it is considered of great importance that awards should be given on performance and not on appearance only.

In conclusion the writer wishes to record his indebtedness to Mr. P. A. Mörkeberg, of Copenhagen, and to Mr. Nils Wassberg, of Malmö, not only for assistance in planning his visit, but for supplying so much detailed information concerning methods of pig breeding in their respective countries.

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AGRICULTURAL EDUCATION FOR WOMEN IN BELGIUM.—II.

From a Report submitted by Miss A. E. Wark, Chief Woman Inspector, Board of Education, and Miss E. H. Pratt, Woman Inspector, Ministry of Agriculture, to the Interdepartmental Committee of the Board of Education and the Ministry of Agriculture.

Middle Level Schools.—The aim of these schools (Enseignement Ménager Agricole du Degré Moyen) is the provision of instruction for girls of 14 years and upwards in all the housewifely and agricultural duties which will fall to their lot, either

as paid assistants on farms or as wives and daughters of farmers. These schools are important, not only from the point of view of numbers, but also as the most firmly established part of the general system. Although not carried to so advanced a stage, the scheme of training reproduces the main features of the Laeken curriculum. The pupils are all resident, and they undertake the work of the house as part of their training, so that there are no paid domestic servants.

Instruction.—The course may last one or two years and is both theoretical and practical, with greater emphasis on the latter. It is given by persons who must either be " régentes " or certified teachers with a diploma of " enseignement ménager agricole," assisted by professors of agriculture and horticulture. All the schools visited were under the direction of a woman principal.

The main subjects are dairy work and domestic economy, together with the elements of natural history, agriculture, horticulture, care of live stock, pedagogy and hygiene, and an introduction to business methods and account keeping. Proper provision for the practical work in connection with these subjects (*e.g.*, dairy and kitchen installation) is obligatory under the regulations of the Ministry of Agriculture.

Examination and Scholarships.—The final examination is conducted by a Board, consisting of a representative of the Ministry and members of the teaching staff, and, in the case of a " provincial " school, of a representative of the province. The teaching staff assess the value of the year's work and the written examination results, and the Joint Board awards marks for the practical and oral examinations. Certain scholarships are available at these schools for pupils who satisfy conditions laid down by the Ministry of Agriculture.

Administration.—From the administrative standpoint these " middle " schools fall into two divisions, viz., those established and controlled by the provinces (or counties), and administered through a special committee (Comité de Direction), and those which are convent schools. Both types are inspected and aided by the Ministry of Agriculture.

School at Rivierenhof (Deurne).—Two schools of " provincial type " were visited, Rivierenhof and Quatrecht. Rivierenhof is admirably situated in an excellent new building in a public park, the property of the province of Antwerp. At the time of this visit there were 53 pupils in residence. Class rooms and laboratories are spacious and well equipped. Each

pupil has a separate bedroom, which is well designed and well furnished. The building, of plain but pleasant exterior, is constructed on most approved modern lines, fitted with central heating and electricity for light and power. Every attention has been given to labour-saving arrangements, which is an important matter when no paid labour is employed Similarly, on the educational side, no effort has been spared to secure the latest scientific apparatus, thereby permitting the work to be carried on under the most modern conditions. This already applies to all indoor work and to practical instruction in horticulture. Opportunities for outdoor work on the agricultural side (milking, poultry-keeping etc.) are not yet so complete, but the proposed reconstitution of the farm buildings will effect the improvement desired by the committee and required by the regulations of the Ministry of Agriculture.

Provincial School of Quatrecht.—Quatrecht differs from Rivierenhof in that a school for boys exists side by side with that for girls. During the past year 34 girls and 56 boys were in residence. This school is in no sense co-educational; two buildings exist side by side, each intended to be self-contained as regards residence, staffing and educational provision. At the time of the visit, owing to temporary difficulties on the farm side in the girls' department, farm buildings in the boys' school were being used for the housing of stock. Unfortunately time did not permit of a visit to the boys' department.

The building, though new, and possessing excellent classrooms, etc., appeared to have been planned on a less elaborate scale than that at Rivierenhof. There were, for instance, cubicle-dormitories instead of separate bedrooms, and in other respects the impression was gained that expenditure was a serious consideration. At the same time the school was marked by an atmosphere of vigorous work directed by an able staff.

Schools at Cortemarcq and Saffelaere.—Two schools of convent type were visited, viz., Cortemarcq and Saffelaere, which, although the property of different sisterhoods, had much in common. Both were housed in excellent new buildings, one provided out of provincial, the other out of reconstruction funds, eked out by contributions from money raised by the nuns. The buildings remain the property of the Order. The development of this "enseignement ménager agricole" in convent schools has been advantageous both to the nuns and the State. Since the State is not involved in capital expenditure and only makes an annual grant, the extension of such education is obtained

economically. The schools on their side welcome it as an enlargement of their field of usefulness, enabling them to reach a type of pupil who would otherwise be neglected. The nuns take every opportunity of qualifying as " régentes agricoles."

Each school comprises three branches—an ordinary convent boarding school, an " école ménagère agricole moyenne " and a village elementary school. The supervision and assistance of the Ministry of Agriculture is confined to the " école ménagère agricole."

Convent School at Celles.—Another large convent school seen at Celles-lez-Tournai consisted of four departments, a training college, a boarding school, a preparatory school for boys and an " école ménagère agricole moyenne." The instructional side of the last named was in separate premises with a special staff and came under the supervision of the Ministry of Agriculture. It was admirably housed in an old farmhouse, whose dairy, kitchen, etc., had been adapted for the purpose; the setting of this school, surrounded by the convent gardens, was as charming as that of any visited. There appeared to be a combination of the homely associations of the old farmhouse with the most modern methods of farm work and instruction, and the inspiring influence of the capable " Directrice," who seemed singularly well fitted for her work, was felt everywhere.

The residential accommodation of the convent, shared by the agricultural students in common with the others, resembled that of the newly-built training college in being extremely up-to-date and generously planned: agricultural students not only had the benefit of the good sleeping and bathroom accommodation provided, they also shared the use of the gymnasium, art room, museum, etc.

Convent School at Barry-Maulde.—The smallest " école ménagère agricole " visited was at Barry-Maulde; it formed part of a convent which was a branch of a bigger establishment at Leuze. It was interesting to find facilities for instruction in cooking and dairy work in so small a school (numbering from 30 to 40 pupils). An impression was gained that good practical work was done at this school, and this was confirmed by the fact that, in 1923, a pupil of this establishment succeeded in winning the " coupe de la vaillante fermière," open to competition by pupils from all " écoles ménagères agricoles." The small numbers are conducive to individual attention and the old-world atmosphere of the school assists in reproducing ordinary home conditions.

Instruction on the Lower Level.—The third class of house and farm management training (Enseignement Ménager Agricole du Degré Inférieur) is given in the itinerant schools (écoles ambulantes), short courses (cours abrégés), and non-residential post-scholastic courses (sections ménagères agricoles primaires).

Itinerant Schools.—It is understood that there are about 2,500 villages in Belgium, so the problem of rural adult education is of some magnitude. Experience has proved that one of the most effective means of meeting the country women's needs is the travelling school (école ambulante), designed to provide training in rural domestic economy for women and girls over school age who are unable to attend the more permanent schools. This type of instruction has accordingly been considerably developed in the last few years. The "école ambulante" is set up in suitable premises in the village, draws students from the surrounding district, and provides an intensive course of four months' duration. Tuition is given by fully qualified teachers employed by the Ministry of Agriculture, and an attendance of from 15 to 25 scholars is normally secured.

Caravan School.—A travelling school of a distinctive type was seen, viz., the caravan school (école roulotte), specially created for service in the devastated area. As regards aim, staffing and curriculum it conformed to the accepted standard of the "école ambulante." The particular interest of the school lies in its ingenious construction and the fact that, as it can so easily be moved from place to place, either by motor or horse traction, it can be utilised in centres where other accommodation would be lacking.

The whole structure consists of four separate caravans, each approximately 28 ft. by 9 ft., which are erected on a selected site in accordance with the following plan. Two of the caravans are placed side by side; the contiguous walls are removed, so that the inner space makes one large class room. The two remaining caravans are set up at right angles to the others, one at each end; in this case there is no removal of partitions but each end-caravan communicates by a door with the central portion. The walls taken from the first two caravans help to form a shed enclosing the yard formed by the projecting end of the cross-way caravans. A corner of the yard is partitioned off for sanitary purposes, the remainder serves for storage of water, bicycles and other goods.

The class room is a large, bright, airy room, which is equipped with tables (used both for practical work and for

meals), ironing stove, and sewing machines, and contains a library and cupboards as well as cloak pegs for all the students. The disposition of furniture, etc., is so good that the room does not appear in any way overcrowded. One of the crossway-caravans contains the dairy, completely equipped with churn, separator, refrigerator, etc., and provided with separate compartments for the drying and ripening of cheese. Water is readily accessible as the door of this van leads down into the yard. Electricity is provided by a battery in the dairy. At one end, partitioned off, is a bedroom containing two beds of the bunk type, and all essential bedroom furniture; and an office sitting-room for one of the teachers. The other crossway-caravan contains the kitchen, beautifully equipped with a coal range, table, cupboards, sink and bath. A bedroom and office-sitting-room (similar to those described in the corresponding caravan) completes the accommodation. Steps from the kitchen lead down to the yard conveniently for water and stores. The caravan is lighted by electricity, provided by the battery in the dairy. Bedrooms and sitting-rooms are all attractively furnished. The standard of pupils' work both in the dairy and the class room was high and the service of meals both as regards table appointments and cooking reflect great credit on all concerned. The excellent attendance showed how much this provision was appreciated.

Women Advisers on House and Farm Management.—A general outline has already been given of the duties of the Women Advisers (Conseillères ménagères agricoles). A meeting of a "cercle de fermières" at Barry-Maulde provided an opportunity of seeing one of the "conseillères" at work. The lady who acts in that capacity for the province of Hainault delivered a useful lecture on the principles of fruit preservation; this appeared to be much appreciated by the audience, and it was expected that it would be followed by requests for further lectures and for advisory visits, with consequent extension of the lecturer's influence in the neighbourhood. The "conseillères" and their assistants, through their work in the "écoles ambulantes," the "cours abrégés," which they give in the intervals of other work, and their close connection with the Women's Institutes, establish touch with every type of country woman. They appear to be admirably qualified to gain the confidence of such women, to ascertain the directions in which help is required, and to satisfy such needs. It was

interesting to discover that instruction in rural domestic economy is provided, in one form or another, in some 200 villages under the supervision of the "conseillères." Nor is their influence limited to women; they frequently address mixed audiences, and they are in close touch with the "agronomes" (agricultural advisers), who are working in each province.

Non-Residential Post-Scholastic Courses.—The most recent development of work of the "degré inférieur" is represented by the "sections ménagères agricoles du degré primaire," which, since 1923, have been organised as post-school courses for girls leaving the elementary school at the age of 14 A course of 200 hours instruction is given, spread over two years. Such sections have been arranged in 34 schools, distributed in 8 provinces. Special training courses for the teachers in charge were instituted by the Ministry of Agriculture in each province. This development has already been referred to in the notice of visits paid to Berlaer, Saffelaere and Cortemarcq; no such class was seen under instruction, but from information given the impression was gained that the course, both on the domestic and the agricultural side, was largely practical.

State of Agriculture.—This brief inspection of agricultural education for women in Belgium gives rise to various reflections. In the first place, it is impossible to spend any time in that country without being impressed by the energy and enthusiasm devoted to the promotion of agricultural prosperity. This has no doubt been quickened by the necessity of post-war reconstruction, but the fact remains that, both as a source of national wealth and as a means of ensuring a pleasant, healthful and independent livelihood for a large portion of the population, the highest importance is likely to be permanently attached in Belgium to the industry of agriculture.

The position of the industry in Belgium may be summarised from the following figures supplied by the Ministry of Agriculture :—The area of Belgium is approximately 2,945,040 hectares. Of that total about 1,947,900 hectares (*i.e.*, about 66.2 per cent.) are devoted to agricultural and horticultural production. The estimated value of the agricultural products of Belgium is 6,500,000,000 francs, and the number of cultivators (farmers of all grades) is probably about 820,000. Assuming that the cultivator receives about 8 per cent. of the value of his products it would appear that the average annual profit of the farmer would be 275 francs per hectare. The number of persons engaged in agriculture in Belgium is 1,204,000 (688,000 men and

516,000 women). Of that total, 1,015,000 persons (558,000 men and 457,000 women) are members of the occupier's family, while 187,000 persons (128,000 men and 59,000 women) are permanent agricultural labourers or farm servants. In addition to cereals, the principal crops are sugar beets, potatoes and chicory, and, in connection with this cultivation, sugar factories and buildings for the drying of chicory are seen in many districts.

Women's Work and Training.—It is evident that the women play a considerable part in the economy of the farm. They not only do the housework, including cooking (and often baking), but they work in the fields and are largely responsible for the feeding of stock, the conduct of the dairy and the management of the poultry yard. Such participation is not limited to the farmer's womenfolk, for the wife of the labourer also appears to take an active interest in her husband's allotment and attends with him lectures that may be organised by the "cercles horticoles" or other educational associations.

Agricultural education is looked on as the most efficacious means of reviving agriculture, since its effect is greatly to increase agricultural productivity and, at the same time, to make life on the land more interesting and more satisfying, thereby stemming migration to the towns. Increased attention is consequently being devoted to agricultural education in general, and, largely owing to the sympathetic administration of the Ministry of Agriculture, there is now general appreciation of the fact that the education of the women of the countryside is no less important than that of the men. It is realised that the success of the farm depends largely on the womenfolk, who must therefore have the chance of acquiring the agricultural knowledge requisite to enable them to exercise general oversight, or to assist in any farming operation. They should also be specially trained in the branches of farm work which more usually fall to the women's share, viz., care of young stock, dairywork, poultry-keeping and gardening. Last, but by no means least, it is understood that the countrywomen must be helped in the task which is peculiarly hers, the creation and the maintenance of the country home.

In arranging then for the training of women in the rural districts, the Belgian Ministry of Agriculture has been inspired throughout by the idea that the women are co-partners in the holding and helpmeets in the home. There has been no question, therefore, of regarding instruction for them as an afterthought, a mere appendage to the existing scheme of

training for men. It has rather been held that facilities for women should be equal though complementary to those provided for men. As a result, a system has been evolved which, while furnishing both sexes with opportunities to qualify in the agricultural work which may fall to the lot of either, makes special provision for separate training in those tasks which more naturally devolve on men or women as the case may be. This is the explanation of that instruction in rural domestic economy for women which is the subject of this report.

Merits of the Belgian Scheme.—With regard to that special training, there is no doubt that it is admirably organised and that it is meeting a genuine need. The services of the "Conseillères ménagères agricoles," including the organisation of "écoles ambulantes," of "cours abrégés," isolated conferences and advisory visits, ensure satisfactory provision of elementary type for adult women and girls over school age. The "sections ménagères agricoles primaires" may be looked on both as providing an excellent supplement to primary school education and as laying a splendid foundation for any corresponding course in agricultural education which may be taken up in later adult life. The "écoles ménagères agricoles moyennes" supply a complete training in rural household science for the daughters and prospective wives of smallholders and farmers. The apex of this graduated but homogeneous system is the college at Laeken, which provides for the preparation of the personnel needed to staff the schools and classes in which, on various stages, this "enseignement ménager agricole" is being carried out.

The countrywoman then, no matter what her position or her prospects, finds a helping hand held out to her by the State. Whether she wishes to devote herself to social service in the country, to inspect or teach, or to share in the practical work of farm or cottage there are opportunities open to her to qualify for the work in view. Her training is every whit as important in the eyes of the Government as that of the industrial or professional worker in other spheres.

This two-fold recognition of the woman of the countryside as the arbiter of the rural home, and consequently the determining factor in the rural exodus, and as a most important contributor to agricultural production (inasmuch as she is responsible both for some of the output of the farm and for its conversion and utilisation, either for consumption or exchange), is a notable achievement. Belgium is to be congratulated not only on the discovery of the fact, but on the prompt and effective measures taken to turn it to account.

OBSERVATIONS AND EXPERIMENTS ON APPLE SCAB IN EAST ANGLIA.

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THIS article contains observations on the incidence of apple scab and further data showing that the damage caused by it can be largely reduced by spraying.

Winter Spore Stage of the Fungus.—Following Salmon's* discovery of the existence in this country of the winter spore stage (perithecia) of the scab fungus on the previous season's leaves, we decided to examine a number of dead apple leaves to ascertain if this method of overwintering is at all common.

On 14th March, 1925, we found these winter spores on over-wintered leaves of Worcester Pearmain, and at that date they were mature. Further examination showed these to be present on leaves of Chivers' Seedling, Bramley's Seedling, Jolly Miller, Allington Pippin, Stirling Castle, Bismarck, Early Julyan, Lord Grosvenor. Leaves from the Wisbech area also revealed this winter stage. It should be noted, however, that the attack of scab during 1924 was exceptionally severe, and it is possible this winter spore stage (perithecia) may not always be so prevalent.

Several hundred dropped apples that had overwintered were also examined, but no winter spores were found, although fruits of Bramley's Seedling found at Wisbech in March were black with the summer spores.

Data submitted by Horticultural Organisers.—The varieties showing the heaviest twig infection in this area are Cox's Orange Pippin, Allington Pippin, Worcester Pearmain, Bismarck and Lane's Prince Albert; and although evidence appears to show that there is more twig infection on the heavier than on the lighter soils, there is also evidence that there is more scab on the fruit on light soils in the Wisbech district (W. G. Kent, Isle of Ely).

In Essex, Mr. R. Hart says: "There is a most marked difference in the severity of the attack on Cox's Orange Pippin according as to whether it has been spur-pruned or the new wood left long." Also "that soil, climate and aspect have a greater effect upon the incidence of scab than variety." In several areas it is thought that fruit trees from the heavier soils are more scabbed than those on the lighter soils.

* This *Journal*, Vol. XXXI, Sept., 1924.

Severity of Attack of Scab in various Counties on Varieties in 1924—1925.

A denotes severely attacked. B denotes less severely attacked. C denotes comparatively resistant to attack.

Variety	Essex		Norfolk		Herts.		Cambs.		Isl of Ely (Wisbech area)		Hunts.		Holland (Lincs.)	
	1924	1925	1924	1925	1924	1925	1924	1925	1924	1925	1924	1925	1924	1925
Allington Pippin ...	B	B	—	C	—	B	A	C	A	B	A	B	—	B
Annie Elizabeth	B	B	B	—		—	—	—	B	C	C	C	—	—
Beauty of Bath	BC	B	—	—	—	—	—	—	B	C	—	B	—	B
Bismarck	A	A	A	—		A	A	—	—	AB	A	A	—	—
Blenheim Orange	C	B	A	—	—	—	—	—	—	—	—	C	—	—
Bramley's Seedling	BC	C	B	—	—	—	BC	C	B	C	C	C	—	C
Chivers' Seedling	—	—	—	—	—	—	A	AB	—	—	—	—	—	—
Cox's Orange Pippin ...	A	A	A	C	A	—	A	—	A	AB	A	AB	—	B
C. Ross	B	C	—	—	—	—	—	—	B	B	—	B	—	—
Devonshire Quarrenden ...	A	A	—	C	—	—	—	—	—	A	—	—	—	—
Duchess of Oldenburg	—	—	—	—	A	—	—	—	—	A	—	—	—	—
Emneth Early (Early Victoria)	B	C	B	C	—	—	—	—	A	AB	B	B	—	B
Gascoyne's Scarlet	B	B	—	—	—	—	—	—	—	—	—	—	—	—
Gladstone	B	B	A	—	—	—	—	—	B	C	—	B	—	B
Grenadier	BC	BC	C	—	—	—	—	—	C	C	—	C	—	B
James Grieve	A	B	—	—		—	—	—	B	B	—	—	—	—
King Edward	—	—	C	—		—	—	—	—	C	—	—	—	—
King of the Pippins ...	A	BA	—			—	—	—	—	B	—	B	—	—
Lady Sudeley	BC	BC	—	C	—	—	—	—	—	BC	—	C	—	—
Lane's Prince Albert ...	B	C	B	C	A	—	A	—	B	B	—	BC	—	B
Lord Derby	B	BC	C	—	—	—	—	—	C	C	C	C	—	B
Lord Grosvenor	C	C	—	—	—	—	—	—	A	AB	—	—	—	—
Newton Wonder	C	C	A	—	—	—	—	—	B	B	C	—	—	B
Peasgood's Nonsuch ...	C	BC	—	C	—	—		—	—	—	B	—	—	—
Ribston Pippin	—	B	A	—	—	—	—	—	—	—	—	—	—	—
Rival	C	C	—	—	—	—	—	—	—	—	—	—	—	—
Royal Jubilee	C	C	—	—	—	—		—	—	C	—	—	—	—
Stirling Castle	A	B	—	—	—	—	—	B	C	BC	—	C	—	B
Sturmer Pippin	A	A	—	—	A	—	—	—	—	—	—	—	—	—
Warner's King	BC	B	—	—	A	—	—	—	B	BC	—	BC	—	—
Wellington	—	B	—	—	A	—	—	—	—	B	—	—	—	—
Worcester Pearmain ...	AB	A	A	C	—	A	A	AB	A	AB	B	AB	—	A
Rev. W. Wilks	B	C	—	—	—	—	—	—	—	—	—	—	—	—

Mr. F. Tunnington (Hunts) reports "during 1925, Cox's Orange Pippin and Worcester Pearmain looked very clean upon the lighter soils, but on the heavier soils showed it (scab) freely."

Spraying Experiments, 1923.—These were carried out near Cambridge on Worcester Pearmain. The date of the first spraying was 14th May and of the second spraying 29th May. The spray fluids, the number of trees, and the results are given in Table I.

TABLE I.

Plot	*Spray*	*Number of trees in plot*	*Percentage of Scabbed fruits*	*Percentage of "Russetted" fruits*
A	Lime-sulphur 1 : 60	16	28	Very little
B	Control	11	71	0
C	Bordeaux 10 : 3 : 40	16	16.5	39
D	Bordeaux 10 : 3 : 40 0.4 per cent. lead arsenate	18	26	40

Rosy aphis (*aphis malifoliæ*) was bad on all the plots. The second spraying caused a fair amount of scorch on the Bordeaux plots and much less on the lime-sulphur plot. Although the Bordeaux plots were the cleanest, they also contained a large number of "russetted" and cracked apples.

Spraying Experiments, 1925.—The following experiments at Wisbech were carried out in conjunction with Mr. W. G. Kent, Horticultural Superintendent of the Isle of Ely.

A plantation of rather large and dense apple trees of the variety Worcester Pearmain, in the orchard of Mr. A. Shuker, North Brink, Wisbech, was selected for the experiments. The trees were on grass land, about 18 years old, averaging 18 to 19 ft. in height, with an average spread of 21 to 22 ft., and were planted 24 ft. by 27 ft. apart. Each row contained 4 trees and each plot consisted of two rows, except the control plots, each of which consisted of one row. The ground sloped upwards towards the river and the soil was lighter at the river end. Plot 1 was furthest from the river and the plots continued in order without missing any trees, except that a chicken run, including 4 rows of trees, separated Plots 4 and 5. There was one row of trees beyond Plot 1 and several rows beyond Plot 9. These trees and those in the chicken run were sprayed twice with a fungicide with good results.

The spraying outfit was a barrow type, hand-power machine and one lance (*bent near the nozzle*). The nozzle was adjusted to give a fine mist-like spray. The spray fluids were lime-sulphur, Bordeaux mixture made on the 8 : 8 : 100 formula and

on the excess lime formula 25 : 7½ : 100, and a proprietary brand of Bordeaux arsenate paste. As in commercial practice it is usual to add arsenate of lead paste to fungicides, so that the number of sprayings may be limited, 5 lb. of that paste per 100 gal. were added to the lime-sulphur and Bordeaux spray mixtures. For the first spraying, lime-sulphur was used at a strength of 1 in 30, or 1⅓ gallons in a 40-gallon tub, and for the second spraying at 1 in 60, or ⅔ gallons per 40-gallon tub. In each case 2 lb. of arsenate of lead paste per 40 gallons was added just before use.

For the Bordeaux mixtures, a solution of copper sulphate at the rate of 1 lb. to 1 gallon of water was prepared overnight, allowing the copper sulphate to remain in a bag in the water, suspended from a stick placed across the top of the containing vessel. For a 40-gallon tub of Bordeaux mixture of the 8 : 8 : 100 formula, 3⅕ lb. of fresh unslaked quicklime was gradually slaked in a bucket, which was kept covered by a bag to retain the heat generated by slaking. When the lime was thoroughly slaked to a fine powder, water was added to make a milky liquid, which was strained through sacking into a tub of water, in which sufficient space was left for the addition of 3⅕ gallons of the copper sulphate solution just before using, and for a final addition of 2 lb. of arsenate of lead paste.

The excess lime Bordeaux mixture of the 25 : 8 : 100 formula was made similarly, except that 10 lb. of quicklime were used instead of 3⅕ lb. In default of Buxton lime, Wirksworth (Derbyshire) lime was used, but great care was taken to ensure that no partially slaked pieces were used. The commercial Bordeaux arsenate paste was used at the rate of 5 lb. to 40 gallons of water.

The sprayer's object was to cover every part of the tree with fine particles of the spray fluid without causing them to run together and drip. It was necessary to keep the nozzle constantly on the move, at a distance of about 2½ or 3 ft. from the branch actually being sprayed, allowing the fine drops of fluid to settle lightly on to the leaves of the tree rather than attempting to wet the leaves.

The first spraying took place in fine, warm weather on 13th May, when the pink colour of the unopened blossoms was showing. Those trees which were to be treated twice received a second spraying on 3rd June, in hot, sunny weather, after the blossoms had fallen and the fruit had just set.

On 3rd June some slight damage from scorching by the first application was noted on the lime-sulphur and on all the Bordeaux mixture plots. The damage was mainly confined to the small, earliest developed leaves, some of which were caused to fall. The greatest leaf-fall was noticed on the 8 : 8 : 100 Bordeaux plots and the least on the lime-sulphur plots. No injury of economic significance was apparent, and no dropping of the fruit as a result of spraying was noticeable.

The presence of scab was first noticed on the leaves on 23rd May. Later on, records were taken of the amount of scab on the leaves and fruit. These are recorded in Table II. The percentages of scab on the leaves are based on counts of 250 leaves per tree—2,000 leaves for each plot. The percentages on 17th June are based on counts of 200 apples per plot and those of 6th August on 1,000 apples per plot. (In the case of the controls half this number was taken).

TABLE II.

Treatment	*Percentage of Scabbed leaves* 17.6.25	*Percentage of Scabbed fruits* 17.6.25	6.8.25
Lime-sulphur and lead arsenate (twice)	0.35	0.5	6.1
Lime-sulphur and lead arsenate (once)	4.75	6.5	11.6
Control (untreated)	12.5	25.0	24.2
Bordeaux and lead arsenate (twice)	2.65	4.5	4.5
Bordeaux and lead arsenate (once)	7.35	11.5	19.5
Control (untreated)	20.4	42.0	48.8
Excess lime Bordeaux and lead arsenate (twice)	0.5	9.0	8.2
Excess lime Bordeaux and lead arsenate (once)	0.6	4.0	5.0
Commercial Bordeaux arsenate paste	1.6	—	13.2

The figures on the control plots show that the incidence of scab is very variable, but the contrast with the figures on the sprayed plots is sufficient to show that the spraying had a marked effect. The fruit was thinned twice at the end of August and the bulk picked during the first fortnight in September. The dropped apples were graded separately, and in all cases gave approximately the same percentage of scab as those picked from their respective trees. A very small percentage of the apples on these plots were attacked by the apple capsid bug.

The crop was a good one, being approximately 4 tons per acre,

and the fruit was graded carefully by hand into three grades as follows :—

(*a*) Free from scab.
(*b*) Showing slight scab spots, but scarcely depreciated in value.
(*c*) Showing scab spots which distinctly depreciated their market value.

A few of the apples showed injury in the form of russetting (often associated with cracking). It was thought that this might be due to the spraying, so a record of such fruit was kept on several plots.

Detailed figures are shown in Table III :—

TABLE III.

Plot	Spray fluid	Rows	No. of trees	Percentage of apples (nearest whole number) Clean	Slightly scabbed	Badly scabbed	Injury Russetting per cent.	Average crop per tree lb.
1	Lime-sulphur + lead arsenate (twice) ..	2 & 3	8	75	17	8	not recorded	140
2	Lime-sulphur + lead arsenate (once) ...	4 & 5	8	53	29	18	,,	173
3	Control (unsprayed) ...	6	4	28	28	44	,,	93¼
4	Bordeaux mixture 8 : 8 : 100 + lead arsenate (twice)	7 & 8	8	81	8	8	3	110
5	As No. 4 (once) ...	13 & 14	8	38	31	29	2	127
6	Control (unsprayed) ...	15	4	13	23	64	trace	82
7	Excess Lime-Bordeaux mixture 25 : 8 : 100 + lead arsenate (twice)	16 & 17	8	74	11	14	1	139
8	As No. 7 (once) ...	18 & 19	8	58	24	17	1	128
9	Proprietary Bordeaux arsenate paste ..	20 & 21	6	51	23	25	1	70

In these plots no fall of fruit as the result of spraying was noticed, and the figures show an increased yield on all the sprayed plots. It will also be noticed that the lime-sulphur plots gave the highest yields, but it is possible that the heavier soil at this end of the plantation may have assisted in this.

The once-sprayed plots all gave a much higher percentage of clean fruit than the controls, and the twice-sprayed plots a higher percentage still. The cleanest plot was the 8 : 8 : 100 Bordeaux, which gave 81 per cent. of clean apples and only 8 per cent. of badly scabbed ones, whereas the control plots gave an average of over 50 per cent. of badly scabbed fruit

The proprietary brand of Bordeaux arsenate paste was distinctly inferior to the other sprays used under the conditions of this experiment. Mr. Shuker's explanation of the low yield of this plot (Plot 9) is that " the leaves were more severely

attacked by scab in 1924 when they were not sprayed, whereas all the others were sprayed with commercial Bordeaux mixture.

It is calculated that two sprayings of Bordeaux mixture gave an increase of £30 per acre in the value of the fruit in this particular case.

Experiments carried out near Cambridge.—These experiments were designed to test the efficacy of winter sprays and also sprays usually recommended. The trees were of the variety Worcester Pearmain, about 20 years old, situated in an orchard belonging to Messrs. Chivers & Sons, of Histon. A petrol sprayer working four lances was used, and the nozzles were adjusted to give a fine mist-like spray. The number of trees in each plot was from four to six.

The yield of fruit on these trees was very variable, and was much reduced by a combined attack of apple sawfly and codling moth. Table IV gives details of the sprays used, dates of application, and the results obtained.

TABLE IV.

Plot			*Fruit per tree lb.	*Clean Per cent.*
1.	Copper sulphate 1 per cent.	9th Oct. 1924	31	38
2.	Tar-distillate wash 10 per cent.	,, ,, ,,	32	37
3.	Soft soap and soda 1 per cent. of each	,, ,, ,,	22	34
4.	Control		20	24
5.	Copper sulphate 1 per cent. ...	9th March, 1924	24	33
6.	Tar-distillate wash 10 per cent.	,, ,, ,,	20	59
7.	Soft soap and soda 1 per cent of each	,, ,, ,,	8½	51
8.	Control		15½	27
9.	Excess lime Bordeaux (7½ : 25 : 100)	9th May, 1925	41	64
10.	Normal lime Bordeaux (8 : 8 : 100)	,, ,, ,,	15	87
11.	Lime-sulphur (1 in 50) ...	,, ,, ,,	19½	74
12.	Control		10	57
13.†	Lime-sulphur (1 in 60) ...	29th May, 1925	21	32
14.†	Normal Bordeaux	,, ,, ,,	15	80
15.†	Excess lime Bordeaux	,, ,, ,,	29½	64
16 †	Control		36	30

Here again the percentage of scab on the control plots varied considerably, one plot having as much as 75 per cent. while another was below 50 per cent. Spraying in October had little effect on the scab, but spraying with a tar-distillate wash or with soft soap and soda in March appears to have reduced the scab somewhat; copper sulphate at this date was apparently not effective. Normal Bordeaux (8 : 8 : 100) again gave a higher percentage of clean fruit than lime-sulphur or excess lime

* Picked on 7th September. Fallen apples were neglected as these showed roughly the same percentage of scab

† These were routine sprayed with a carbolineum wash before Christmas.

Bordeaux mixture. No appreciable spray damage was noticed. In this case the weight of fruit per tree was very variable, as the control plots ranged from 10 to 36 lb. of fruit per tree.

Experiments in Huntingdonshire.—Mr. F. Tunnington, Horticultural Organiser for Huntingdonshire, has kindly sent the following figures obtained by spraying Worcester Pearmain in a plantation belonging to Mr. W. Afford at Bluntisham. The treatment and results are given in Table V:—

TABLE V.

Plot	*Treatment*	*When sprayed*	*Yields per Tree* *Bushels*	*Scab* *per cent.*	*Grade I* *per cent.*	*Grade II* *per cent.*	*Grade III* *per cent.*
3.	Lime-sulphur 1 in 30 + lead arsenate 0.5 per cent.	before blossoming	2½	15	80	15	5
4.	Control		2¼	25	65	30	5
6.	Lime-sulphur 1 in 60 + lead arsenate 0.5 per cent.	after fruit set	2¼	20	75	20	5
8.	As 3 and 6		2¾	2	94	4	2

In Grade I one spot of scab (if small) was included. On Plot 8 two sprayings of lime-sulphur were very effective in reducing scab and also in increasing the yield.

Slight fruit drop after spraying was noticed on all plots, including the control.

The following figures were obtained by us on 20th and 21st August, in a plantation near Cambridge, which was sprayed with 7½ per cent. tar-distillate wash on 10th February, 1925:—

TABLE VI.

Variety	*Treatment*	*"Scab" Percentage*	*Position*
Chivers' Seedling	Tar-distillate wash 7½ per cent.	19	End of Orchard
" "	Untreated	33	" "
Chivers' Seedling	Tar-distillate wash 7½ per cent.	26	Middle of Orchard
" "	Untreated	32	" "
Allington Pippin	Tar-distillate wash 7½ per cent.	2	End of Orchard
" "	Untreated	2	" "
Stirling Castle	Tar-distillate wash 7½ per cent.	1	End of Orchard
" "	Untreated	13	" "
Stirling Castle	Tar-distillate wash 7½ per cent.	7	Middle of Orchard
" "	Untreated	5	" "

Counts were made of 1,000 apples per plot, except in one case in which 1,500 were taken. The trees in the middle of the orchard were more dense than at the end. Dead leaves that were examined from this orchard showed the winter spores to be present. This orchard had not previously been sprayed.

Influence of pre-Blossoming Spraying on the amount of Scorch caused by Spraying after Blossoming.—Interesting observations on the above have been made near Wisbech and in Norfolk. Mr. W. G. Kent states: "Lane's Prince Albert trees sprayed once only (after blossoming) with 1 per cent. lime-sulphur were badly scorched and nearly half the leaves fell from the trees as a result, whereas, similar trees in the same plantation suffered very little damage when sprayed with 1 per cent. lime-sulphur after blossoming; but these trees had been sprayed before blossoming with 1 in 40 lime-sulphur.

Mr. H. Goude gives further information on this subject: "Apple trees sprayed with 1 in 40 lime-sulphur immediately before blossoming took 1 in 60 a month later without any injury to the crop. Trees sprayed at the end of June (that had not been previously sprayed) dropped a large number of leaves and fruits. The leaves most affected were the small ones in the basal clusters. The large primary leaves were not injured so severely. Several commercial varieties were included, but Lane's showed more injury than any other varieties. A further six trees of Lane's sprayed with lime-sulphur (1 in 80) about the first week in July shed more than 50 per cent. of their leaves and dropped practically all their fruit. These trees had not previously been sprayed. The weather was hot with bright sunshine. The same strength of lime-sulphur used on trees during dull weather did not do any injury while the patches of scab were killed on the leaves by the wash."

Summary.—1. During the spring of 1925 the winter spore stage (*i.e.*, perithecia) was abundant on dead leaves of many varieties of apple.

2. Twig infections are heaviest on certain varieties.

3. Character of soil appears to influence the severity of attack.

4. Incidence of scab on many varieties is given for 1924-1925.

5. Worcester Pearmain were badly russetted by excess lime Bordeaux mixture (with or without lead arsenate) in 1923 but not in 1925.

6. Scab on Worcester Pearmain was economically controlled in 1925 by spraying with either normal Bordeaux mixture, excess lime Bordeaux mixture or lime-sulphur (with or without lead arsenate).

7. One per cent. lime-sulphur sprayed once only (after blossoming) caused serious injury to the leaves of Lane's Prince Albert; but no injury resulted on those trees which had been previously sprayed with lime-sulphur, 1 in 40.

RECENT INVESTIGATIONS ON SILVER-LEAF DISEASE.

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TOWARDS the end of 1922, additional facilities for the investigation of Silver-leaf Disease, under the direction of the present writer, were provided through the Development Fund, by a five-year period grant administered by the Ministry of Agriculture and Fisheries. These facilities consist of the provision of a small commercial plantation of Czar plums near Cambridge, and of a greenhouse on the farm of the University School of Agriculture in which experiments on fruit trees in pots can be carried out under controlled conditions. This increased assistance has enabled experiments to be performed on a much larger scale than was previously possible, and has allowed certain lines of investigation to be prosecuted which could not be undertaken formerly. In addition, certain experiments have been performed at the East Malling Research Station and at the John Innes Horticultural Institution by the kindness of Mr. R. G. Hatton and the late Mr. W. Bateson respectively. Since 1922 the writer has been greatly helped in these investigations by his technical assistant, Mr. W. C. Moore, now Assistant in the Pathological Laboratory of the Ministry of Agriculture and Fisheries. A fuller account of the results of these investigations to date will appear shortly as " Silver-leaf Disease, V," in the *Journal of Pomology and Horticultural Science.*

Earlier work had shown that the fungus *Stereum purpureum* was the primary cause of this serious disease of fruit trees, the results having been published by the writer and his associates in a series of papers entitled " Silver-leaf Disease, I-IV." Much, however, still remained to be found out about the disease when an opportunity was afforded for an extension of the work.

Problems for Elucidation.—At the commencement of these extended investigations two of the problems most requiring elucidation in Silver-leaf Disease were to determine whether *Stereum purpureum* infects wounds in fruits trees with equal facility at all times of the year, and to ascertain whether fresh exposures or old wounds were more liable to invasion by this fungus. Experiments carried out month by month for more than two years show that the spores of *Stereum purpureum* can readily bring about infection of fresh exposures of the wood of susceptible varieties of plums during all months of the year

except June, July and August. During the latter months it is practically impossible for the spores of the fungus to cause infection. The reason for this is that the physiological state of the tree in the summer enables it to react much more vigorously to wounding and to the initiation of invasion by the fungus than in other months, with the result that such a large amount of gum is formed near the exposed surface as to impose an impassable barrier to the fungus. Although the fungus may begin to enter a wound during these months its progress is quickly stopped by the formation of a "gum-barrier," and infection does not result. In view of these results the cutting out of branches of fruit trees should be done in *the early part of the summer* as the chances of infection by *Stereum purpureum* are then reduced to a minimum.

It has also been ascertained that fresh wounds in woody tissues are much more liable to invasion by this fungus than tissues which have already been exposed some time. Thus, if, during the susceptible months of the year, a large number of wounds are made in a Czar plum tree and some are inoculated within a few days with the spores of the fungus, others inoculated after a month and others after three months, it is found that whereas infection occurs up to 100 per cent. in the wounds inoculated almost immediately, only occasionally does infection result after the lapse of a month, and not at all after three months.

Protective Substances for Wounds.—From the last result it is clear that any protective substance placed over wounds in fruit trees should be applied immediately after the exposure is made, if *Stereum purpureum* is to be kept at bay. Many substances have been tested with a view to discovering a means of protection for wounds which would effectively prevent infection by this fungus and at the same time be harmless to the tissues. As a result of extended trials, both Stockholm tar and gas tar have been found incapable of preventing invasion by *Stereum purpureum*. Soft grafting wax is an excellent wound protective, and paints made up in the following way have also given very good results in preventing infection by this fungus.

(*a*) ***Red oxide paint.***—To 2 lb. red oxide in linseed oil (as bought) add two teaspoonfuls of paste driers and about a tablespoonful of linseed oil. Mix. Then add turpentine gradually, and mix well until about ½ pint has been incorporated.

(*b*) ***White lead paint.***—To 2 lb. white lead paste as bought add two teaspoonfuls of paste driers and two tablespoonfuls of linseed oil. Mix. Then add two tablespoonfuls of turpentine and mix well.

When made in this way these paints have the most suitable consistency for application to wounds.

Recovery without Treatment.—Attention has been called in previous papers on Silver-leaf Disease to the recovery of silvered fruit trees without treatment. There is no doubt that natural recovery from the disease, even in susceptible varieties of plums such as Victoria and Czar, is more frequent than was formerly supposed, provided that the trees are growing vigorously. The following figures indicate the potency of the recovery factor in a group of mature Czar plums kept under observation during the last three years:—

		No. healthy in 1925.
No. slightly silvered in 1922 ...	19	13
No. moderately silvered in 1922...	28	15
No. heavily silvered in 1922 ...	11	0

Although the slightly and moderately silvered trees show a high degree of recovery, none of the heavily affected trees have recovered completely, indicating that it is almost hopeless to expect recovery after the disease has progressed beyond a certain stage. On the other hand, with trees of poor growth the amount of recovery is negligible and the disease usually goes from bad to worse. Thus in another group of 93 Czar trees, of about the same age as those previously mentioned, but of weak growth, which were moderately silvered in 1923, only one has recovered, 24 have remained silvered to approximately the same extent or have become worse, and no fewer than 66 have died.

Where trees recover naturally from the disease, it has been found that health is regained by the copious formation of gum in the tissues on the margin of the invaded zones of wood, produced by the reaction of the tree, which leads to the formation of a "gum barrier" that cannot be traversed by the fungus. In this way the fungus is prevented from invading further healthy tissues and dies out in the course of time. Only trees of a certain vigour of growth can produce sufficient gum to stay the progress of the fungus.

Manurial Treatment.—Attempts have been made to increase the rate of recovery of silvered trees by manurial treatment to promote the maximum vigour of growth without undue succulency. Although it is too early to make a confident statement about the effect of manurial treatment, it can be said that no striking changes in the rate of recovery have been

obtained in this way, although in some of the experiments applications of kainit and basic slag have been attended by some improvement.

Test with Proprietary Remedies.—Claims are sometimes made that certain proprietary substances will cure Silver-leaf Disease, although, as far as the writer is aware, no details of experiments with them carried out with an adequate control test have yet been published. Some of these substances have now been tried by the writer on a large scale with proper control experiments, and, as far as these tests have gone, there is no evidence that the claims made for these substances to cure the disease are well founded. The following are the results of three experiments carried out with one of the substances, as advised by the makers:—

Experiment I (1923-5), Victoria Plums.—4 applications of the proprietary substances were given, *i.e.*, 2 each year. Of 9 silvered trees that were treated, 5 are now healthy. Of 10 silvered trees left untreated, 3 are now healthy.

Experiment II (1923-5), Victoria Plums.—4 applications of the proprietary substances were given, *i.e.*, 2 each year. Of 14 silvered trees that were treated, 5 are now healthy. Of 14 silvered trees left untreated, 7 are now healthy.

Experiment III (1922-5), Czar Plums.—13 trees have received 7 applications of the proprietary substances, and 3 trees 5 applications, *i.e.*, 2 or 3 applications each year. Of 16 silvered trees that were treated, 10 are now healthy. Of 35 silvered trees left untreated, 18 are now healthy.

Ring-barking.—It is also sometimes claimed that the disease can be cured by cutting away a narrow ring of bark about two-thirds of the way round the circumference of the silvered branch or main stem a short distance below the level supposedly reached by the fungus. Large-scale experiments are being made to test the validity of this claim. The following results are so far available:—

In 1923, 46 moderately and heavily silvered Czar plums of weak growth were ring-barked either once or twice, 22 trees similarly silvered being kept as a control. In 1925, the results were as follows:—

Trees ringed once (18)	*Trees ringed twice* (28)	*Control* (22)
10 dead	20 dead	14 dead
5 heavily silvered	3 heavily silvered	4 heavily silvered
1 moderately silvered	1 moderately silvered	1 moderately silvered
1 slightly silvered	1 slightly silvered	1 slightly silvered
1 healthy	3 healthy	2 healthy

A similar experiment is in progress with vigorous Victoria plums, and although it is not yet complete, the figures for 1925 may be given.

Trees ringed once (19)	*Trees ringed twice* (18)	*Control* (17)
1 heavily silvered	12 moderately silvered	10 moderately silvered
10 moderately silvered	5 slightly silvered	6 slightly silvered
5 slightly silvered	1 healthy	1 healthy
3 healthy		

There is no significant difference in these results in favour of ring-barking.

Tests for Susceptibility.—At the East Malling Research Station all the plum stocks in common use have been tested for susceptibility to Silver-leaf Disease by artificial inoculation with *Stereum purpureum*. The disease can be induced in all these stocks by inoculation, although Myrobolan B shows a high degree of resistance. All the plum stocks in commercial use, however, exhibit a pronounced tendency to recover from the disease, and there is no doubt that they are far less susceptible than Victoria and Czar plums. The influence of the type of stock upon the susceptibility of the cultivated variety to the disease is of an indirect nature. Data are gradually being accumulated in regard to this, but, from the nature of the inquiry, it will be some time before a confident statement can be made

Treatment.—(1) The Silver-leaf Order of 1923 directs that dead wood in fruit plantations liable to harbour *S. purpureum* should be cut out by 15th July. The date was originally suggested because the spores of the fungus are least abundant in the air during the early summer and because it is then easy to distinguish the dead branches. The results described above clearly indicate that it is almost impossible for the spores of the fungus to cause infection in the early summer, and for this reason also the date given in the Order is appropriate. Fruit-growers should aim at getting this work done in *June*, as there will then be a period of about two months before the fungus is again readily able to cause infection. There is no doubt that the common practice of thinning out fruit trees in the winter is fundamentally wrong from the standpoint of plant pathology, however convenient it may be as regards the utilisation of labour. Throughout the winter *S. purpureum* is violently infective.

(2) Whether it is advisable or not to cut out silvered branches of fruit trees depends chiefly upon their condition and upon the skill with which the operation is done. If the trees are

growing well, the silvered branches may be left unless they begin to die back, for there is a reasonable chance of recovery. With apple trees the chances of recovery are particularly good. Some fruitgrowers, however, who take particular care of their trees, have controlled the disease very successfully by cutting out, *during the early summer*, branches in the initial stages of silvering.

(3) Plum branches frequently break in heavy-cropping seasons unless they are supported, and branches are sometimes broken by carelessness in picking the fruit. Such wounds are a prolific source of infection by *S. purpureum*. These broken branches should be cut back flush with a larger branch or main stem directly after the fruit has been gathered.

(4) All wounds more than ¼ inch across should be protected either with soft grafting wax or with one of the paints described in this article. The protective should be applied immediately after the wound is made.

(5) The vigour of the trees should be maintained as high as possible by careful selection of land and young trees, and by suitable cultivation. On some soils a potash or phosphatic manure may be advantageous in increasing vigour. Emphasis is laid upon a robust habit of growth in the trees, as it is only vigorous trees that stand a reasonable chance of recovery if attacked by Silver-leaf Disease.

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MARCH ON THE FARM.

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Seasonal Operations.—The field husbandry ordinarily intended to be carried out during March and the beginning of April includes sowing spring oats, barely, vetches and perhaps grass seeds; planting potatoes; cross ploughing and working land for green crops; top dressing, harrowing, and, if necessary, rolling winter corn, lea and old grass land; ploughing sheep folds, and carting out manure for immediate or later application. At this time of the year especially are the differences

between light dry and heavy wet land and between dry and humid localities most marked. On the same day I have seen fine barley tilths being made in Lincolnshire while the bulk of the land in Derbyshire was unfit to touch.

In midland and southern districts *oats* are so liable to frit-fly attack, if sown later than March, that priority must needs be given to the sowing of this crop. Heavy rates of seeding—6 bushels per acre—are generally advisable with the newer sorts; and if the crop follows mown lea or corn, it will be profitable to apply a complete dressing of artificials with the seed.

Fields intended for *mangolds or sugar beet* should be lightly stirred as soon as they begin to assume a dry appearance and are fit to carry the team. Spring ploughing for these crops may be beneficial, but after the middle of March it should be avoided if possible, the desired tilth being obtained by tillage with tine implements in successive operations of gradually increasing depth. Where practicable, it is advantageous to draw the land up in ridges a few weeks before the date intended for sowing. By chain harrowing along the ridges at sowing time, seedlings of annual weeds are destroyed and a firm moist surface is exposed in which the crop seed germinates well. A full plant is ensured by this means, unless the soil is deficient in lime, in which case the seedlings are apt to turn yellow and die off in patches.

Where the sward of *grassland* has become weak owing to repeated cutting up by the feet of cattle, a little permanent seeds-mixture should be sown on the weak places during this month. Thin patches gradually become green during the summer without such aid; but running weeds such as crowfoot and annual grasses often comprise much of the new growth, unless suitable grass seeds are sown out in the spring. This method, coupled with the use of fertilisers, has been practised with success in the improvement of poor pastures. Fields with a tendency to become matted should be severely harrowed: dressings of soil, and especially calcareous mud, have a very beneficial effect in such cases.

Meadows are as far as possible kept free of stock during March, as if a dry spring follows late grazing, a light yield of hay may be obtained. Where the meadows cannot be rested for long, quick-acting fertilisers should be applied as soon as the sheep or cattle are removed. To replenish the reserves of hay, depleted during the hard weather of the past winter, top dress-

ing of meadow land may be more necessary than usual this year.

Seed Mixtures.—In these notes last March attention was called to the difference between a grazing and a mowing mixture for one-year lea. Italian rye-grass and broad red clover are superior to perennial rye-grass and late-flowering red clover where autumn keep in the maiden year and early growth in the following spring are important considerations. The latter two have, however, proved the better combination for a single cut of hay in the north of England. Whether it is generally superior to the former in southern districts has yet to be proved; but it would seem that on farms where there is a large area of mangolds or sugar beet to be singled it may be of some advantage to use a mixture that comes to maturity a week or two later than broad red clover and Italian rye-grass.

In some districts the risk of getting a thin or missed plant is increased by delay in sowing; this applies particularly to the case of seeds sown in wheat or winter oats. The end of March is not too early for seeding down in winter corn, provided that the land is dry enough to form a proper tilth for the purpose.

Farmers who are seeding down land to permanent grass should distinguish between mixtures suitable for pasture and those required for land intended to be mown. Unfortunately, few public experiments have been carried out with permanent meadow mixtures; but there is evidence that in this case it is not wise to rely on a very simple mixture or to expect the use of basic slag and wild white clover to play such an important part in meadow making as they do in pasture formation.

Roots in the Ration.—At the present moment one of the questions that is being most widely discussed among farmers is that of whether a cow will yield more milk on a ration consisting of hay and concentrates only or one that includes an allowance of roots. Strangely enough the question of cost appears to be receiving little consideration. Many farmers are experimenting in a small way with no-roots feeding, but their results are very conflicting. One thinks he has proved that roots are essential for the best milk yields; another thinks he has proved the opposite; while a third is confused by the fact that his cows rose in yield when he reduced the roots and commenced heavier feeding of concentrates, but the rise was soon followed by a marked fall. As a rule these experiments do not produce reliable information, because generally they are not planned with proper regard for starch equivalents, protein content, and other factors of importance.

A typical example of a misleading experiment. which unfortunately was given wide publicity as a "proof" of the superiority of no-roots feeding, is that conducted by a young man connected with the corn trade, who had been feeding his cows indiscriminately on a ration comprising roots, fodder and meals of the Indian meal, rice meal and thirds class. On commencing to feed a ration of hay with a compound cake properly apportioned at the rate of 3½ lb. per gallon of milk yielded, plus a little extra for the newly-calved cows, the milk yield increased. What the result proved was not that roots are valueless, but that the original ration was deficient in protein and that concentrates should be fed according to yield.

If we are not to disregard the systematic research and investigation underlying Kellner's starch equivalents, Armsby's net energy values and the Scandinavian fodder units, we must accept as an established broad principle that 3 stones of roots are of the same feeding value as 3½ lb. of maize, 4 lb. of rice meal or 4¾ lb. of oats. There are of course different kinds and varieties of roots, and differences occur in the quality of the same sort of root; differences also occur in the quality of corn and meals. No simple comparison can be made, however, between roots and cake or meal richer in protein than the three foods above mentioned.

The moisture in roots may have an additional value where the cows have only limited access to water; and under certain conditions, particularly in northern and exposed districts with a long winter, roots appear to have important beneficial effects on the health and breeding properties of cows. Messrs. Sanders and Hammond referred to this in the February issue of this *Journal.** A Kent correspondent also informs me that during the winter of 1921-22 he fed his herd without roots and that the cows maintained their winter yield of milk fairly well; but they produced less satisfactory calves and their yields in the lactations following were in nearly all cases diminished.

High Yields of Milk.—In the last volume of the Ministry's "Register of Dairy Cattle with Authenticated Milk Records," particulars are given of 77 cows in respect of which Certificates of Merit had been awarded. These cows had each yielded between 2,400 and 4,800 gallons of milk in the three years 1922-24 and calved three times during that period. By courtesy of the owners of 60 of these animals, I have been able to obtain

* See also this *Journal*, p. 992, February, 1924.

information regarding the rations fed to them, which is summarised and classified in the following table :—

Group.	Whether roots or silage fed.	No. of cows.	Breeds.	Average yield per cow per annum.	Average quantity fed per cow per day. Roots.	Silage.
				gallons	lb.	lb.
1	Roots	33	25 S. ...	1036	56	—
			3 cross ...			
			1 L.R. ...			
			2 S.D. ...			
			1 A. I. D.			
2	Silage	7	4 B.F. ...	1029	—	39
			3 R.P. ..			
3	Roots and Silage	12	12 S. ...	936	12	7
4	No roots, no silage	3	3 S. ...	895	—	—
5	Roots	5	5 Jerseys	885	19	

In the same connection it may be mentioned that moderate rations (45-50 lb.) of roots were and still are fed to the herds which won 1st and 2nd places in the 1924 and 1923 competitions for the Silcock Cup, the herd averages of the first herd being 1,402 and 1,513 gallons. The Harold Jackson Trophy for the highest 3 years' yield was won in 1923 by a cow "Daisy" in one of the above two herds; and in 1924 by another cow "Bess," not in either herd but whose ration included 45-50 lb. of roots, as did at least four of the five cows placed next in order of average yearly yield. viz., 1,600-1,354 gallons. "Spot," the winner in 1925 of the Morrison Trophy for the greatest total of points at three consecutive dairy shows, has always had all the roots she can eat, and she eats about 3½ bushels of cut roots a day. She has given an average of 15,555 lb. for the last 4 years. "Mayflower," the Ayrshire cow that won the British Dairy Farmers' Association medal and the Barnham cup in 1925, had 40 lb. of swedes per day before and at the show.

The above and abundant other evidence available shows that root feeding is not an obstacle to heavy yields of milk. The fact that only three of the above 54 merited cows were dry-fed, and these three were all spring calvers, supports the view that dry feeding is not conducive to the best results over a long period.

In all questions concerning yields of either stock or crops, however, cost of production is a factor that cannot be ignored. The highest yield is not necessarily associated with the best

profit. An extra quarter of corn yielded under ordinary treatment by a more productive variety or strain may cost very little; but the same increase forced by heavy manuring, etc., from a less prolific sort may involve financial loss. Similarly the extra 100 gallons may be either very profitable or of doubtful economy according to its method of production. The main factor is undoubtedly the milking propensities of the cow. The second consideration, viz., the relative costs of roots and other foods will be discussed in a future article; meanwhile it may be observed that it is not in the arable but in the all-grass districts where farmers find winter milk production so difficult and expensive.

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NOTES ON MANURES FOR MARCH.

SIR JOHN RUSSELL, D.Sc., F.R.S.,
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When Kainit is used for Roots should it be Applied at the Time of Sowing or Earlier?—There is a general belief among farmers that the earlier application is the better, so as to give the salt present in the kainit time to wash out. No good direct test seems to have been made in this country, but there is much information from which guidance can be obtained. Of the crops that benefit by potassic fertilisers some respond to salt in addition and some do not. Mangolds, for example, respond to salt even when liberally treated with potassic fertilisers. For such crops the kainit should not be applied beforehand but at the time of sowing; there would be no advantage, but rather a disadvantage, in losing the salt. Other crops do not benefit by salt, or if at all only rarely. For potatoes neither salt nor kainit should be used. Swedes and turnips, when they need potash (which is not always) do not usually respond to salt as well; if kainit is used for them it should be applied before sowing.

The more economical plan, however, is to use kainit for mangolds and for meadows on lightish soil, both of which benefit by the salt, but to use the muriate for swedes or turnips which do not benefit by salt, and the sulphate for potatoes. The small saving in buying kainit as compared with the muriate is hardly worth achieving at the cost of lessened effectiveness.

Should Nitrate of Soda be Applied to Mangolds at the Time of Sowing or of Singling?—This question was recently raised at a farmers' lecture. Application at the time of singling is

best for nitrate of soda or nitrate of lime, but the time of sowing is probably the best for sulphate of ammonia. The difference lies in the rapidity of action of the manures, and the ease with which they are washed out from the soil; the nitrates are quicker in action and more readily lost; they need not therefore be given until they are actually needed. For potatoes and barley the sulphate of ammonia is known to be better applied with the seed than later; for swedes, however, the later application is better. All these crops have been made the subject of definite trials. For mangolds the information is less certain, but it is probable that the application with the seed is the better. The experimental results with potatoes and swedes are as follows:—

POTATOES.

YIELD IN TONS PER ACRE.

	All sulphate of ammonia given with seed.		*Half of sulphate of ammonia given with seed, half as top dressing.*
Basal manure alone	8.03	...	—
" " + 3 cwt. sulphate of ammonia	9.41	...	9.16

SWEDES.

YIELD IN TONS PER ACRE.

Unmanured	24.03
Basal	25.67

	All applied late.		*Half top dressed, half with seed.*
Basal manure + ¾ cwt. sulphate of ammonia	26.10	...	—
Basal manure + 1½ cwt. sulphate of ammonia	28.20	...	27.31

Is there any Difference between one form of Lime and Another in Affecting Potato Scab?—This question arose at a farmers' lecture in Cheshire where the soils generally need lime for the clover crops, and yet if it is given the highly important potato crop is liable to suffer through scab. It is unsafe to assume any difference in action between one form of lime and another; the best procedure is to put on the dressing of lime immediately the potatoes are removed, and not to give more than is necessary to satisfy the needs of the crops in the one rotation. Farmers wishing to ascertain this quantity should consult the County Organisers who are usually in a position to give useful advice.

Use of Farmyard Manure for Potatoes.—A question of perennial interest at farmers' lectures is the quantity of farmyard manure that should be used for the potato crop; whether 10, 15 or 20 tons per acre. Dairy farmers often have sufficient manure to give the larger dressings and some of them do so.

There is always a temptation to treat liberally a good cash crop like the potato, nevertheless, it is by no means certain that the policy of putting on 20 tons per acre is sound, if this is done at the expense of other crops on the farm that would benefit from the manure. It is notorious in hop-growing districts that some growers tend to give most of their dung to the hops, and so starve the rest of the farm. Where as much as 20 tons per acre has been given for potatoes, it is worth trying to see whether better results would be obtained by using less, say 15 tons per acre, and giving the dung thus saved to other crops on the farm, *e.g.*, a light dressing to the seeds ley. The potato crop generally does better with a mixture of artificials and a moderate dressing of dung than with a large dressing of dung alone, and the farmer would probably gain by giving a good complete dressing of artificials such as 2 cwt. sulphate of ammonia, 2 cwt. sulphate of potash, 3 cwt. superphosphate per acre along with 12 to 15 tons farmyard manure per acre, instead of a larger dressing of dung and a smaller dressing of artificials.

Plant Food for Broad Beans.—Recent Rothamsted experiments have shown that broad beans and certain other leguminous crops are peculiar in requiring a very small quantity of borax before they can make full growth. Probably most soils contain enough of this substance for plant requirements, but it may happen that some soils do not, and peculiarities in growth such as stunting, failure to develop or to pod well, might be observed. The Rothamsted authorities wish to be notified of any examples of this kind that may occur so that they may if possible go further into the matter.

Effect of Lime and Limestone on Drawbar Pull.—Considerable interest has been aroused among farmers by the recent Rothamsted measurements showing the saving in drawbar pull and in power required for cultivations resulting from the addition of chalk to the land. In this present season it is shown that the chalk applied in 1913 is still making a considerable difference to the work; the drawbar pull on the unchalked land being 1,400 or 1,500 lb. for a two-furrow plough, while that on the chalked land is less than 1,250 lb. As the improvement has now lasted for 12 years and looks like lasting much longer, it is obvious that a farmer should not judge of the advantage of chalking or liming simply by the weight of the crop. On some of the heavy land overlying chalk in the Home Counties, *e.g.*, in Berkshire, it is known that chalking will reduce three-horse land to two-horse land. Experiments are being arranged to try

whether lime has as good an action as chalk, and also what size dressing of lime is needed to give a sufficient improvement. These experiments are necessarily slow and costly, but they will be carried through as speedily as the work can be arranged.

* * * * * *

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	*Average Price per ton during week ending Feb. 10th.*				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	13.12	...	13.5	13.10	17. 5
" " Lime (N. 13 per cent.)	...	12.10	...	12. 0‡	18. 6
Sulphate of Ammonia, neutral (N. 21.1 per cent.)	12.18*	12.18*	12.18*	12.18*	(N)12.3
Kainit (Pot. 20 per cent.)	3.10	3. 0	...	..	...
" (Pot. 14 per cent.)	3. 0	2.15	2.14	2.16	4. 0
Potash Salts (Pot. 30 per cent.)	4.15	..	4. 8	4.10	3. 0
" " (Pot. 20 per cent.)	...	...	3. 1	3. 3	3. 2
Muriate of Potash (Pot. 50-53½ per cent.) ...	9.10	8. 2	8. 7	9. 7	3. 6
Sulphate of Potash (Pot. 48-51½ per cent.) ...	11.10	10. 5	10.10	11. 5	4. 5
Basic Slag (T.P. 34 per cent.)	...	...	3. 4§	3. 5§	1.11
" " (T.P. 30 per cent.)	...	...	...	2.17§	1.11
" " (T.P. 28 per cent.)	...	2. 8§	...	...	...
" " (T.P. 26 per cent.)	...	2. 3§	...	...	...
" " (T.P. 24 per cent.)	2. 9§	1.19§	1.18§	...	...
Ground Rock Phosphate :— (58 per cent Tribasic Phosphate of Lime) ...	2.17¶	...	...	2.12¶	...
Superphosphate (S.P. 35 per cent.)	3. 6	...	3.14	3. 6	1.11
" (S.P. 32 per cent.)	...	...	3.11	...	...
" (S.P. 30 per cent.)	3. 0	2.17	3. 7	3. 0	2. 0
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	8.15	8. 5	8. 5	7.15	...
Steamed Bone Flour (N. ¾, T.P. 60-65 per cent.)	6. 0†	6.10†	5.10	5.10	...
Fish Guano (N. 6¼, T.P. 10 per cent.) ...	...	...	...	9. 0	...
Burnt Lump Lime	1. 8	1.12	1.18	2. 1‖	...
Ground Lime	1.15	...	2. 8	1.15‖	...
Ground Limestone	1. 7	...	1. 4	..	..

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ Delivered in 4-ton lots in the Home counties.

§ Prices include cost of carriage from works to town named. Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire. London prices are f.o.r. at Northern London Stations. Cost to purchasers in other districts will be greater or less according to the distance of different purchasers from the works.

‖ Delivered in 4-ton lots to London.

¶ Fineness 80% through standard screen of 10,000 holes to the square inch. Price at London is for 4-ton lots f.o.r. at Northern London Stations, and at G.W.R. and S.R. London Stations the cost to purchasers is 55/- per ton.

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MONTHLY NOTES ON FEEDING STUFFS.

E. T. HALNAN, M.A.,
Animal Nutrition Institute, Cambridge University.

The Rôle of Mineral Substances in Animal Nutrition.—The work of Evvard and others in America, and that of Orr and others in Great Britain has emphasised the necessity of providing adequately for the demands of the animal for minerals as well as for protein and energy, and striking cases of malnutrition due to lack of mineral substances have been demonstrated. The need for the addition of mineral substances to diets has long been recognised by stock-feeders, and the provision of green bone for poultry, and rock salt for farm animals, has been for many years an established agricultural practice. Our knowledge of the physiological laws governing the action of minerals on the body is, however, still largely empirical, and we cannot predict with scientific precision, the effect on the animal of feeding various combinations of mineral salts, although we can, in certain cases, state that administration of certain minerals under well-defined conditions of nutrition, will be followed by beneficial results. We are consequently obliged to base our advice on information obtained by the study of the composition of the animal body and on the composition of the feeding stuffs themselves.

Composition of the Animal Body.—Study of the composition of the fat-free bodies of domestic animals reveals the fact that approximately 4 to 6.5 per cent. of the body consists of ash, and of this nearly 80 per cent. of the ash is derived from the skeleton. Bone varies considerably in composition in different animals and at different ages in the same animal, and consists of varying quantities of water, fat, collagen (a glue-like protein material), and inorganic salts. On the other hand, the composition of the bone ash obtained by incinerating bone is fairly constant, however variable the original composition of the bone may be. Bone ash consists largely of tricalcium phosphate, but in addition there is always present calcium carbonate and phosphates and carbonates of magnesium and other metals such as potassium and sodium. Chlorides and fluorides are also present in very small amounts. The blood, which forms the chief nutritive medium of the body, has an approximately constant composition, both the percentages of mineral salts and the protein, fat, and sugar being maintained at an approximately constant level. The salts present in the blood form but a small propor-

DESCRIPTION.	Price per Qr. s. d.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	§ Starch Equiv per 100 lb.	Price per Unit Starch Equiv. s.	Price per lb. Starch Equiv. d	§ Protein Equiv. %
Wheat, British	—	—	11 17	0 15	11 2	72	3/1	1·65	9·6
Barley, British Feeding	—	—	8 5	0 12	7 13	71	2/2	1·16	6·2
„ Canadian :—									
No. 4 Western	31/3	400	8 15	0 12	8 3	71	2/4	1·25	6·2
„ American	30/9	„	8 12	0 12	8 0	71	2/3	1·20	6·2
„ Russian	29/9	„	8 7	0 12	7 15	71	2/2	1·16	6·2
Oats, English, White	—	—	9 13	0 13	9 0	60	3/0	1·61	7·6
„ „ Black and Grey	—	—	9 5	0 13	8 12	60	2/10	1·52	7·6
„ Scotch, White	—	—	10 0	0 13	9 7	60	3/1	1·65	7·6
„ Canadian :—									
No. 2 Western	30/0	320	10 10	0 13	9 17	60	3/3	1·74	7·6
No. 3 „	28/0	„	9 17	0 13	9 4	60	3/1	1·65	7·6
Feed „	25/3	„	8 17	0 13	8 4	60	2/9	1·47	7·6
„ American	24/9	„	8 13	0 13	8 0	60	2/8	1·43	7·6
„ Argentine	23/6	„	8 5	0 13	7 12	60	2/6	1·34	7·6
Maize, Argentine	34/3	480	8 0	0 12	7 8	81	1/10	0·98	6·8
„ South African	34/3	„	8 0	0 12	7 8	81	1/10	0·98	6.8
Beans, English Winter	—	—	10 5	1 11	8 14	66	2/8	1·43	20·0
Peas, English Dun	—	—	11 0	1 7	9 13	69	2/10	1·52	18·0
„ „ Maple	—	—	11 13	1 7	10 6	69	3/0	1·61	18·0
Dari, Egyptian	—	—	12 0	0 15	11 5	74	3/0	1·61	7·2
Millers' Offals :—									
Bran, British	—	—	6 15	1 6	5 9	42	2/7	1·38	10·0
„ Broad	—	—	8 17	1 6	7 11	42	3/1	1·65	10·0
Middlings—									
Fine Imported	—	—	8 5	1 1	7 4	69	2/1	1·12	12·0
Coarse, British	—	—	7 2	1 1	6 1	58	2/1	1·12	11·0
Pollards, Imported	—	—	6 5	1 6	4 19	60	1/8	0·89	11·0
Meal, Barley	—	—	9 17	0 12	9 5	71	2/7	1·38	6·2
„ Maize	—	—	9 10	0 12	8 18	81	2 2	1·16	6·8
„ „ South African	—	—	8 5	0 12	7 13	81	1/11	1·03	6·8
„ „ Germ	—	—	8 5	0 18	7 7	85	1/9	0·94	10·0
„ „ Gluten	—	—	9 10	1 6	8 4	76	2/2	1·16	19·0
„ Locust Bean	—	—	9 12	0 9	9 3	71	2/7	1·38	3·6
„ Bean	—	—	12 5	1 11	10 14	66	3/3	1·74	20·0
„ Fish	—	—	19 10	4 1	15 9	53	5/10	3·12	48·0
Linseed Cake, English 12°/。 Oil	—	—	13 0	1 16	11 4	74	3/0	1·61	25·0
„ „ 10°/。 Oil	—	—	12 12	1 16	10 16	74	2/11	1·56	25·0
„ „ 9°/。 Oil	—	—	12 5	1 16	10 9	74	2/10	1·52	25·0
Soya Bean „ 6 % Oil	—	—	11 10	2 11	8 19	69	2/7	1·38	36·0
Cottonseed Cake, English 5½°/。 Oil	—	—	6 7	1 13	4 14	42	2/3	1·20	17·0
„ „ Egyptian 5½°/。 Oil	—	—	6 2	1 13	4 9	42	2/1	1·12	17·0
Decorticated Cottonseed Cake, 8 % Oil	—	—	11 15	2 11	9 4	71	2/7	1·38	35·0
Decorticated Cottonseed Meal 7°/。 Oil	—	—	10 10	2 11	7 19	74	2/2	1·16	35·0
Coconut Cake 6°/。 Oil	—	—	8 17	1 10	7 7	79	1/10	0·98	16·0
Ground Nut „ 7°/。 Oil	—	—	8 13‖	1 15	7 0	57	2/5	1·29	27·0
Palm Kernel Cake 6°/。 Oil	—	—	7 2	1 2	6 0	75	1/7	0·85	17·0
„ „ „ Meal 6°/。 Oil	—	—	7 15‖	1 2	6 13	75	1/9	0·94	17·0
„ „ Meal 2°/。 Oil	—	—	6 7	1 3	5 4	71	1/6	0·80	17·0
Feeding Treacle	—	—	7 0	0 9	6 11	51	2/7	1·38	2·7
Brewers' Grains :—									
Dried Ale	—	—	7 17	1 3	6 14	49	2/9	1·47	13·0
„ Porter	—	—	7 7	1 3	6 4	49	2/6	1·34	13·0
Wet Ale	—	—	1 5	0 9	0 16	15	1/1	0·58	4·8
„ Porter	—	—	0 18	0 9	0 9	15	–/7	0·31	4·8
Malt Culms	—	—	7 10*	1 13	5 17	43	2/9	1·47	16·0

* At Liverpool. ‖ At Hull.

§ The figures in these columns have been corrected in accordance with the tables given in the Report of the Committee on the Rationing of Dairy Cows.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of January and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 1s. per ton. The food value per ton is therefore £8 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 5d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·29d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices:—N, 12s. 3d.; P_2O_5, 3s. 8d.; K_2O, 3s. 0d.

tion of the total ash of the body, and it has been shown that the ash of the skeleton forms the chief reservoir or reserve supply for the replenishment of the salts used by the tissues through which the blood is circulating. This explains why it is possible for the animal to exist without detriment for some time on rations which actually are deficient in essential mineral constituents, the minerals required being drawn from the skeleton, and being replaced later when change to a more suitable ration takes place.

Prolonged feeding on a mineral-deficient ration will, however, result in symptoms of malnutrition as soon as the reserve store in the skeleton is nearing exhaustion, and such symptoms will be shown much more quickly by a rapidly growing young animal or an adult in the lactating condition, when the demands for mineral substances are likely to be heavier than in other cases.

Composition of the Ash of Feeding Stuffs.—Study of the composition of the ash of feeding stuffs shows that cereal products generally are low in calcium and high in phosphorus content, whereas fruits, vegetables and particularly leguminous hays are rich in calcium. Leguminous seeds, and protein-rich concentrates contain abundant supplies of phosphorus and are relatively rich in calcium. A normal balanced ration containing legume hay, cereals, and protein-rich foods are not likely under normal conditions to require supplemental additions of minerals except, for reasons too lengthy to state here, perhaps sodium chloride. Farm animals are not likely therefore to require much additional mineral substances to the diet, except possibly heavily lactating animals and pigs whose food naturally consists for the main part of cereal by-products. In such cases, the calcium is best fed in the form of chalk, the sodium and chlorine in the form of common salt, and the phosphorus in the form of bone meal or in the form of substances containing excess of phosphorus. Fish meal and meat and bone meal are especially of value since they contain substances other than calcium and phosphorus, which are essential for the maintenance of an adequate salt balance. Unless the added minerals are given in the form of a feeding stuff such as fish meal or meat meal, it is best from a practical standpoint to allow the animals free choice by providing a mixture of the minerals in a separate trough to which the animals have free access at all times. It is impossible to give general recommendations as to the compounding of mineral salts with feeding stuffs, and for this reason no recommendations are given in this article.

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follows:—

	Starch Equivalent.	Protein Equivalent.	Per Ton. £	s.
Barley (Imported)	71	6.2	8	11
Maize	81	6.8	8	0
Decorticated Ground Nut Cake ...	73	41.0	12	5
,, Cotton Cake ...	71	34.0	11	15

Add 10s. per ton, in each case, for carriage. The cost per unit starch equivalent works out at 2.06 shillings, and per unit protein equivalent, 2.67 shillings.

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values" which it is recommended in the Report of the Committee on Rationing Dairy Cows should be applied by Agricultural Organisers and other advisers in connection with advisory schemes on the rationing of dairy cows, are given in the November, 1925, issue of the Ministry's *Journal.*)

FARM VALUES.

CROPS.	Starch Equivalent.	Protein Equivalent.	Food Value per Ton, on Farm. £	s.
	Per cent.	Per cent.	£	s.
Wheat	72	9.6	8	14
Oats	60	7.6	7	4
Barley	71	6.2	8	2
Potatoes	18	0.6	1	18
Swedes	7	0.7	0	16
Mangolds	7	0.4	0	15
Beans	66	20	9	9
Good Meadow Hay	31	4.6	3	16
Good Oat Straw	17	0.9	1	17
Good Clover Hay	32	7.0	4	2
Vetch and Oat Silage	13	1.6	1	11
Barley Straw	19	0.7	2	1
Wheat Straw	11	0.1	1	3
Bean Straw	19	1.7	2	3

* * * * * *

MISCELLANEOUS NOTES.

Property Acts, 1922 and 1924. Stewards' Fees.

IT will be remembered that under the Property Acts, 1922 and 1924, copyhold land in England and Wales became automatically enfranchised as from the first day of this year.

Until the manorial incidents due in respect of lands affected have been extinguished under the Acts, it will be necessary for all assurances of the land or of any interest therein to be produced to the

steward of the manor for endorsement within six months from the date of the execution of the assurance. For this work and for other duties falling upon stewards pending the extinguishment of the manorial incidents, the stewards will be entitled to such fees only as may be prescribed by the Minister of Agriculture and Fisheries. Owners of property recently enfranchised by virtue of the Acts and stewards of manors will, therefore, be interested to learn of the publication by the Minister of Agriculture and Fisheries of the Enfranchised Land (Stewards' Fees) Regulations, 1926, copies of which may be obtained from His Majesty's Stationery Office.

Under these Regulations, where the steward was appointed before the date of the passing of the Law of Property Act, 1922, and the transaction in question is one in respect of which a customary fee would have been payable if the property had not been enfranchised, the steward will be entitled to the customary fee. In other cases, however, the fee payable will be calculated in accordance with an *ad valorem* scale laid down by the Regulations.

* * * * * *

Egg Marketing.

APART from eggs in liquid condition and egg products, the eggs-in-shell, both fresh and preserved, imported from countries other than Ireland, into the United Kingdom in 1913 totalled 2,590 millions. Under war conditions the number dropped in 1918 to 319 millions, but it has since risen rapidly, reaching 1,870 millions in 1924—or about 73 per cent. of the pre-war figure. What has happened, and may happen, in regard to the remaining 27 per cent., may be regarded as one of the basic considerations of the Ministry's "Report on Egg Marketing in England and Wales,"* the publication of which was announced (p. 877) in the issue of this *Journal* for January last.

Although Great Britain does not rank high in the scale of egg-consuming countries, there is no reason to suppose that the drop in imports is due to diminished consumption Even before the war, the improvement in poultry stocks and their management, together with the introduction of more economical methods of production generally, were leading to a steady increase in home egg production; the specialist egg producer, operating on a large scale, had also come into prominence. During the war-period, poultry stocks were seriously depleted as a result of shortage of labour and feeding-stuffs. The consequent scarcity

*Ministry of Agriculture and Fisheries: Economic Series No. 10, H.M. Stationery Office, 1s. 6d. net.

of eggs and the deficiency in imports were, however, in some degree compensated for by the many thousands of householders who took up poultry-keeping to ensure their personal requirements at reduced costs, while the high prices ruling encouraged specialist poultry-farming and brought many recruits to the ranks of the commercial egg producers.

In the post-war years, there has been some decline in small-scale production but, in the main, it is true to say that the reduction in imports gave a great impetus to home egg production. Since 1921, the number of fowls kept on agricultural holdings in England and Wales has increased by 24 per cent. and now exceeds the pre-war figure, and there is the further fact that the distribution of more prolific strains of fowls during the last 15 years has brought about a substantial rise in the average annual yield throughout the country, which experts put at 100 eggs as compared with pre-war estimates of 80 per laying hen, or an increase of about 25 per cent. There is every indication, therefore, that increased home production has gone a long way, if not the whole way, to meet the discrepancy between the pre-war and the present volume of imports.

That being so, the important question for British egg producers to consider is whether and how they can keep their hold on the increased share of the home egg market that they now possess. Specialist egg farmers, although responsible for but a small part of the total egg production, are an important element in the British poultry industry on account of the uniformity of their output, although specialist egg production, which is not regarded in some quarters as an economic proposition under present conditions, shows a tendency to decline. It is in this matter of uniformity of output as regards quantity and quality that the difficulty really lies. The general farmer and small-holder, who furnish about 80 per cent. of the home supplies are, in the main, apt to regard poultry-keeping as a minor consideration rather than an important feature in their general farming economy. For this reason, while the natural quality of farm-produced eggs, when marketed in good condition, is said to excel that of eggs produced under other circumstances, the supplies from these sources are somewhat uncertain both as regards quantity and quality.

The sources of the eggs imported in 1924 show considerable variations from those in pre-war days. Russia, which supplied more than half the imports of 1913, sent only 5 per cent. and, even including her former territories of Poland, Latvia and

Lithuania, the total was only 16 per cent. Other European sources show a decline. Imports from France, probably on account of export restrictions which may be temporary, have practically disappeared. More distant lands, such as China, Argentina, Morocco, Canada, South Africa, etc., which were insignificant contributors before the war, are now relatively important suppliers. Egypt also shows a notable increase. It is, however, from the competition of the high-grade produce from near-European countries such as Denmark, Holland, Belgium and from Northern Ireland and the Irish Free State that the English egg producers have most to fear. Danish and Dutch supplies, for example, command better average prices than ungraded home supplies on the London market for the greater part of the year; in other large cities, wholesalers and retailers are frequently prepared to pay more for imports of guaranteed quality than for nondescript consignments of English eggs which are from time to time on offer in the local markets. The imports of Dutch eggs in 1924 showed a rise of 3 per cent. over those of 1913, and Danish eggs an increase of no less than 19 per cent. In the competition from these countries quantity and quality are allied. The example of Denmark in maintaining a legislative control over the quality of her egg exports has been followed by others, including Northern Ireland and the Irish Free State. Similar action had already been taken by South Africa and Canada and other countries are known to be contemplating a measure of statutory reform.

It is obvious, therefore, that the present methods and practices in the home egg trade must be improved in many directions to compete with the highly-organised trade of competing countries. The significance of this becomes apparent from a study of the map showing geographical variations in production and demand which appears as a frontispiece to the Report. This indicates the centres of dense population in this country into which eggs have to be moved, the areas which consume practically all the eggs they produce, and beyond these, again, the less-populated rural districts, which have a surplus available. In other words, there are exporting areas within this country which have the same problems to face as, say, the exporting areas of Ireland, Belgium and France, and have no comparative advantage in proximity to markets.

The future of the English egg industry will be largely determined by the quality of the eggs marketed from the general farms of this country, and particularly by the degree of attention

which is given to improving the methods of preparing the home produce for market and retail sale. Improvement embraces questions of collection, grading, preserving, packing and distribution, all of which are very fully discussed in the Report, which indicates certain lines of action that should be considered by everyone interested in this branch of home-food supplies. It is gratifying to note that the National Farmers' Union and the National Poultry Council are now collaborating in the formulation of definite proposals. The result of these deliberations will be awaited with anxiety by all concerned.

* * * * * *

Canadian Egg Marketing Regulations.

IN his Report for the year ended 31st March, 1925, the Canadian Minister of Agriculture states that the year 1924 was one of the most satisfactory in the history of the egg industry, retailers reporting a degree of satisfaction and freedom from complaint hitherto unknown and wholesalers an increased business throughout the whole of the year. Although weather conditions during the summer of 1924 were favourable to the retention of quality, this satisfactory state of affairs is generally attributed in Canadian circles to the standardisation of the product and the general application of the Egg Marketing Regulations, especially those regulations referring to domestic trading.

The Report shows that the moderate prices ruling for eggs, combined with the higher quality offered, had a marked effect on consumption, and emphasises that past failure to increase consumption was due to unreliable quality. Dealers, when buying eggs from various sources, were accustomed to make little or no attempt to sort them, and the produce was sold to the consumer, irrespective of quality, on a flat or one price basis. The Regulations now require that all eggs shall be candled, graded and classified, and that the containers used for sale or delivery shall be marked with the class and grade. Although the expense of candling and grading is not great the enterprise and systematic arrangement of business required has resulted in an uplift to the trade. The Minister concludes by remarking that as the work develops and the expression of the consumer's preference becomes known to the producer in the way of increased returns for the better grades of eggs, there is bound to be a marked improvement in the Canadian egg and in production methods on Canadian farms.

In these circumstances, it is interesting to read the following extracts from comments on the new Canadian Egg Regulations

which appeared in a recent issue of the weekly Egg and Poultry Market Report of the Dominion Department of Agriculture :—

A firm of Distributors remarks :—

"Regarding the grading of eggs, the attitude of the consumer has been very favourable, for now when a housekeeper wants eggs for different purposes she knows what grade to order and is assured that she will get what she pays for. We find that, on the whole, eighty per cent. of the producers are satisfied with the plan. It takes a little time for both parties to become educated to the system, which is of course natural. Regarding ourselves, while more time is required to carry out the grading we have been amply repaid by being assured of the quality of our eggs and by the satisfaction given our customers; for these reasons we heartily endorse the plan."

Another Distributor says :—

"Our farmers as a whole are very well pleased and we think that our retail trade in eggs has increased approximately twenty-five per cent."

A Producer expresses his views as follows :—

"Prior to the introduction of the egg regulations, I, in common with most of the commercial producers, was using every possible care re quality of eggs marketed, but found it hard to compete with the class of eggs thrown on the market as new laid. The regulations as they now stand give the producer every incentive to use care in his shipments since he is paid strictly on grade. The man who makes a point of producing the better class egg can depend upon being paid a price in accordance with quality. The public have now arrived at a discriminating state of mind and appreciate the value of different grades for different purposes. We have found an increased demand from our wholesalers which can only be accounted for by increased consumption. I am absolutely certain that no responsible producer would wish to see the regulations slackened in any way."

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Special Course for Milk Recorders.

A SPECIAL Course on Milk Recording will be held at the Midland Agricultural and Dairy College, Sutton Bonington, Loughborough, from Monday, April 19th, to Saturday, May 8th, 1926. Applications for admission to the Course should be addressed to the Principal. The Course is being held for Milk Recorders and others who intend to take up the work of recording. Students will travel to Sutton Bonington on Monday, April 19th, and tuition will begin on the following day. Each day's instruction will embrace :—

(*a*) At least two hours theoretical teaching.

(*b*) Practical work in weighing, sampling, testing and keeping of records.

At the conclusion of the Course the College will notify in writing those students who have satisfied their Instructors as to

their industry and general ability and have passed the theoretical and practical examination held during the closing days.

SYLLABUS.

(a) *Lectures.*

1. Nature and composition of milk; causes of variation in composition; adulteration and its detection.
2. Food and Drugs Act relative to milk; local regulations concerning milk.
3. Bacteriology of milk; control of bacterial growth; importance of cleanliness; methods of preserving milk.
4. Milk sampling; weighing and methods of sampling; simple and composite samples; method of packing samples for dispatch.
5. Milk testing. Determination of percentage of fat by Gerber method; determination of specific gravity by lactometer and Westphal balance; the Richmond scale; calculations of solids not fat; calculation of averages.
6. Principles and practice of milk recording; Ministry of Agriculture Scheme; why accuracy in detail is essential; discussion of the duties of recorders, with a study of the forms which must be kept; milk record certificates and register of dairy cows; interpretation of milk records; calculation of herd averages; marking of cows; calf and bull marking scheme; method of keeping food records.

(b) *Practical Work.*

Actual milk recording; the taking of simple and composite samples under various conditions; determination of the percentage of fat (Gerber method) and the specific gravity; calculation of total solids; use of the Richmond scale; visits to farms evening and morning to weigh milk and make the necessary entries; checking of records, detection of errors and abnormal results; keeping of food records and calculation of cost of feeding and cost of food per gallon of milk.

* * * * * *

Trials of Potatoes for Immunity from Wart Disease, 1925.

THE trials which are conducted by the Ministry each year with the object of testing new varieties of potatoes as to their immunity from wart disease were again carried out in 1925 on the farm of the National Institute of Agricultural Botany, Ormskirk, Lancashire. The actual field operations and the taking of records were carried out by Mr. Harold Bryan, B.Sc., and Mrs. McDermott, of the Institute, but the trials were conducted on a plan approved by the Ministry.

The results of the trials have been considered by a small Committee composed of representatives of the Ministry of Agriculture and Fisheries, the Board of Agriculture for Scotland, and the Ministry of Agriculture for Northern Ireland, and co-ordinated with the results of the trials carried out at the

testing stations of the two last-named Departments at Philpstoun and Kilkeel.

The findings of the Potato Synonym Committee of the National Institute of Agricultural Botany have been accepted where recommendations as to the classification of varieties as synonymous with existing varieties have been made by that Committee.

The dry weather experienced during the early summer was very unfavourable to the development of wart disease, and in view of the small amount of disease visible on susceptible varieties both at Ormskirk and Philpstoun, it was decided that no first-early varieties could be recommended for approval as the result of the 1925 trials. This decision affected six early varieties on which no wart disease was seen during the trials in 1924 and 1925; a further test will be required before these varieties can be approved as immune.

In addition to these six early varieties, 27 second-early or maincrop varieties successfully passed the test in 1925, but except in 5 cases the growers do not propose to place them on the market at the present time: their inclusion in the approved list is accordingly postponed in order to restrict the list to those varieties which have actually been, or will be, introduced into commerce.

The following are the descriptions of the five new varieties added to the list of those approved as immune from wart disease as the result of the 1925 trials, and of two varieties approved after the 1924 trials, but only recently placed on the market.

Late or Maincrop Varieties:—

"*Celurca.*"

Sprout ... Pink.
Tuber ... Oval; skin white; flesh white; eyes shallow.
Haulm ... Moderately vigorous, upright, open; leaflets yellowish green, medium size; secondary leaflets large, numerous; stem slight coloration at base only; wings markedly crinkled.
Flower .. None observed.

"*Dunaverney.*"

Sprout ... Purple.
Tuber .. White, round to oval.
Haulm .. Medium height, erect; foliage very dark green.
Flower ... White, very profuse.

"*Grannispud.*"

Sprout ... Blue.
Tuber ... Kidney; skin white; flesh white; eyes shallow.
Haulm ... Medium height, spreading; stems branching freely; leaf medium green.
Flower ... None observed.

"*The Mac.*"

Sprout ... Pink.
Tuber ... Round to oval; skin white; flesh white; eyes medium.
Haulm ... Tall, open, upright, moderately vigorous; leaflets small, narrow, dull, very erect; stem slight pink colour at base only; wings straight.
Flower .. White, small, rare, long sepals.

"*Main's Triumph.*"

Sprout ... Purple.
Tuber .. Oval; irregular in shape; skin white; flesh lemon; eyes medium.
Haulm ... Very tall, vigorous and upright; leaflets bronze-green, corrugated, broad, glossy; secondary leaflets large and numerous; stem general reddish-purple pigmentation; wings crinkled.
Flower .. White, numerous, borne on long stalks.

"*Response.*"

Sprout ... Pink.
Tuber ... Oval; skin white; flesh white; eyes shallow.
Haulm ... Tall, upright; stem branching, slightly tinged pink; wings broad; leaf open; leaflets medium green, dull and soft, with waved margin.
Flower ... White, profuse; stalks long; buds green purple.

"*Wonderful.*"

Sprout ... Faint pink.
Tuber ... Kidney, thick; skin white; flesh white; eyes shallow.
Haulm .. Compact, vigorous; leaflets erect, long, broad, glossy, hairy; stem green; wings straight.
Flower .. White.

* * * * * *

Wart Disease Immunity Trials: Season 1926.

THE Ministry will continue during the coming season to test, at the Potato Testing Station of the National Institute of Agricultural Botany at Ormskirk, potatoes and potato seedlings as to their immunity from or susceptibility to wart disease on the conditions stated below.

An entry form (No. 345 H.D.) obtainable from the Ministry should be filled up and returned to the Potato Testing Station, Lathom, Ormskirk, Lancs, *with the requisite fees.* Samples must be sent to the Station so as to arrive *not earlier than 21st February nor later than 31st March.*

Conditions under which Potatoes are Accepted for Trial.

(*a*) Quantity of each stock of potato to be sent for the first time—35 seed size tubers.

Quantity of each stock of potato to be sent for the second and for subsequent years—50 seed size tubers.

(*b*) A fee of 5s. is payable in respect of each stock of potato when first entered for immunity trials. *These fees are not returnable in any circumstances.*

(c) The Ministry while taking reasonable precautions to secure satisfactory growth can accept no responsibility for the failure of any variety.

(d) The Ministry will take all reasonable precautions to secure that all the produce of the trial plots is fed to stock after being thoroughly mixed together, except such portions as may be needed for exhibition or scientific purposes authorised by the Ministry. The Ministry, however, reserves the right to send tubers from the produce grown at Ormskirk for testing at the official stations of the Board of Agriculture for Scotland and the Ministry of Agriculture for Northern Ireland.

(e) The Ministry will furnish as early as possible a report on each stock forwarded.

(f) When the Ministry is satisfied as a result of the trials that a variety is immune from wart disease it will formally " approve " the variety and will issue an official certificate of immunity. Certificates will not be issued for any variety until it has passed at least two consecutive years' tests without contracting the disease. Special consideration will, however, be given to the case of any old-established varieties submitted for testing. No certificate will be issued for a variety which is declared by the Synonym Committee of the National Institute of Agricultural Botany to be synonymous with an existing variety. If a variety is tested under a number or letter, and approved, a sample of 100 tubers of the variety as named will be required for comparison with the tested stock.

Trials of Seedlings.—The Ministry desires to encourage the breeding of new varieties of potatoes, and in order to provide information for breeders of seedlings it is prepared to accept not fewer than 2 tubers, and not more than 10 tubers of any seedlings for growing for one season on the trial plots, and to furnish a report on the results obtained without payment of a fee. These tests, however, will not be considered as forming part of the immunity trials proper, and will not be reckoned in the minimum period of two years referred to under (f). The results of these tests will not be included in any report issued by the Ministry.

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Importation of Plants into Canada.

REFERRING to the note which appeared in the issue of this *Journal* for June, 1925, p. 283, the Ministry has been requested by the Canadian Department of Agriculture to remind exporters of plants, that the importation into Canada of merchandise packed in hay, straw or other fodders is prohibited, unless accompanied by a certificate, from a properly qualified Government veterinary officer of the country of origin, that such hay, straw or other fodder has been grown and stored, and the merchandise packed, in a district not

infected with foot-and-mouth disease, or unless accompanied by a certificate from a properly qualified Government veterinary officer that the packing has been thoroughly disinfected. It should be noted that the term " fodder " includes *all products of the fields, e.g., chaff, rice hulls, buckwheat hulls, sphagnum moss, etc.*

It is understood that pulverised peat, excelsior, charcoal, wood wool, sawdust, or paper may be used without the certificates referred to above.

* * * * * *

Purity of Parsnip Seed.

THE Regulations made under the Seeds Act, 1920, require in the case of a sale of parsnip seed, that the seller shall deliver to the purchaser a statement in writing containing certain specified particulars, including (1) the name and address of the seller; (2) a statement that the seeds have been tested in accordance with the provisions of the Act; (3) the kind of seed; (4) the percentage of purity if below 97 per cent.; and (5) the percentage of germination; provided that if the percentage of germination is not less than the authorised minimum percentage (45 per cent.) prescribed in the Schedule to the Regulations, a statement to that effect, which shall include the authorised minimum percentage of germination, shall be sufficient.

Owing to the structure of the parsnip seed, it frequently happens that the percentage of purity falls below the 97 per cent. prescribed in the Seeds Regulations, the impurities being mainly " light " and imperfect seeds. The sale of such seed is not contrary to the Regulations provided the actual percentage of purity is declared.

* * * * * *

Enforcement of Minimum Rates of Wages.

DURING the month ending 15th February, legal proceedings were instituted against five employers for failure to pay the minimum and overtime rates of wages fixed by the Orders of the Agricultural Wages Board for workers in agriculture.

The particulars of the cases are as follows:—

County.	*Court.*	*Fines.*	*Costs.*	*Arrears of wages ordered to be paid.*	*No. of workers concerned.*
		£ s. d.	£ s. d.	£ s. d.	
Oxford	Watlington	10 0 0	2 15 0	7 4 8	2
Northants	Kettering	6 10 0	3 10 0	23 12 7	5
Derby	Derby	3 0 0	0 15 0	38 1 3	3
Kent	Canterbury	8 0 0	—	42 18 8	4
Pembroke	Haverfordwest	1 0 0	—	10 13 1	1

Export of Breeding Stock.

NUMBER and Declared Value of Animals Living, for Breeding, exported from Great Britain and Northern Ireland in the three months ended December, 1925, compared with the corresponding period in 1924.

(From Returns supplied by H.M. Customs and Excise.)

County to which Exported	Oct. to Dec., 1925		Oct. to Dec., 1924	
	Number	Declared Value	Number	Declared Value
CATTLE		£		£
Argentina	67	7,743	33	7,010
Belgium	2	150	4	112
Bolivia	21	1,806	0	0
Chile...	3	500	2	150
Ecuador	0	0	2	60
Uruguay	8	2,800	1	150
British India	5	470	0	0
Irish Free State	1,640	20,874	760	10,384
Kenya Colony	5	421	0	0
Union of South Africa ...	58	4,465	28	1,153
Other Countries	8	476	8	79
Total of Cattle	1,817	39,705	838	19,098
SHEEP AND LAMBS				
Argentina	602	11,655	420	11,922
Bolivia	54	1,962	0	0
Chile...	24	1,185	165	5,021
France	7	75	3	142
Japan	0	0	12	140
Uruguay	159	3,490	102	2,523
Irish Free State	850	3,991	851	2,617
Union of South Africa ...	29	693	0	0
Other Countries	30	1,270	26	733
Total of Sheep and Lambs	1,755	24,321	1,579	23,098
SWINE				
Argentina	2	40	3	74
Bolivia	8	498	0	0
France	3	60	20	287
Germany	12	475	17	426
Japan	3	99	3	148
Peru	6	117	0	0
Russia	50	1,000	0	0
Switzerland	0	0	52	555
Irish Free State	136	789	120	144
Union of South Africa ...	5	160	0	0
Other Countries	5	107	25	246
Total of Swine	230	3,345	240	1,880

NUMBER and Declared Value of Animals Living, for Breeding, exported from Great Britain and Northern Ireland during 1925, with comparative figures for 1924.

Export of Breeding Stock in 1925.

(From "Annual Statement of Trade" and Returns supplied by H.M. Customs and Excise.)

Country to which Exported	1925 Number	1925 Declared Value	1924 Number	1924 Declared Value
CATTLE		£		£
Argentina	509	108,562	273	47,040
Belgium	17	305	5	152
Brazil	12	1,982	4	520
Denmark	42	1,915	0	0
Germany	41	1,944	5	450
Uruguay	69	13,166	92	16,518
Canada	0	0	60	12,780
Irish Free State	5,861	77,938	5,946	74,937
Kenya Colony	30	1,842	14	1,434
Union of South Africa ...	141	12,914	42	2,253
Other Countries	105	6,827	60	3,314
Total of Cattle	6,827	227,395	6,501	159,398
SHEEP AND LAMBS				
Argentina	1,102	24,077	794	20,786
Bolivia	54	1,962	0	0
Chile	27	1,420	173	5,316
Germany	25	546	31	1,239
Russia	205	3,454	0	0
Uruguay	204	4,660	120	2,918
Irish Free State	2,800	9,415	4,683	14,013
Union of South Africa ...	71	1,323	21	230
Other Countries	207	4,678	140	2,278
Total of Sheep and Lambs	4,695	51,535	5,962	46,780
SWINE				
Argentina	13	247	31	1,224
Austria	0	0	781	8,110
Czecho-Slovakia	6	120	81	1,810
France	14	214	69	1,281
Germany	62	1,962	40	1,078
Japan	16	679	28	920
Netherlands...	15	496	19	426
Russia	81	2,088	0	0
Irish Free State	582	2,707	703	1,241
Union of South Africa ...	89	2,019	3	80
Other Countries	124	2,531	116	1,851
Total of Swine	1,002	13,063	1,871	18,021

Foot-and-Mouth Disease.—Since the issue of the February *Journal*, the following outbreaks of foot-and-mouth disease have been confirmed, in Essex, 1; Lancashire, 6; Leicester, 8; Lincoln (Lindsey), 2; Norfolk, 2; Nottingham, 1; Stafford, 3; Warwick, 4; Yorks E.R., 3; Yorks N.R., 5; and Yorks W.R., 2.

New centres have been brought to light at Buttercrambe (Yorks E.R.); Lincoln (Lindsey); Packington (Leicesters.); Newton-in-Cartmel (Lancs.); Birmingham; Leicester; Great Yarmouth; Stoke-on-Trent; Nottingham and Sheffield.

Up to and including 25th February the number of outbreaks since 1st January, 1926, is 40, involving 11 counties.

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Farm Workers' Minimum Wages.—A meeting of the Agricultural Wages Board was held on the 8th February, at 7, Whitehall Place, S.W.1, the Chairman, Lord Kenyon, presiding.

The Board considered notifications from Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and proceeded to make the following Orders carrying out the Committees' decisions:—

Buckinghamshire.—An Order fixing minimum and overtime rates for male workers and minimum rates for female workers to operate from the 1st March to the 31st Oct. (*i.e.*, for the period of "summer" hours). In the case of male workers of 21 years of age and over the minimum rate is 31s. per wk. of 50 hr. (instead of per wk. of 48 hr. as at present) with overtime at 9d. per hr. on week-days and 11d. per hr. on Sundays. For female workers of 18 years of age and over the minimum rate is 6d. per hr.

Lincolnshire (Kesteven and Lindsey).—An Order fixing minimum and overtime rates for male workers and minimum rates for female workers to come into force on the 16th Feb., 1926 (when the existing rates are due to expire), and to continue until the 6th March, 1927. In the case of male workers employed wholly or mainly as wagoners the minimum rate is 39s. per wk. of 52 hr. in summer and 48 hr. in winter, and such additional hours as may be required for the performance of customary duties in connection with the care of horses (but so that the total number of hours per week shall not exceed 61 from the 15th Oct. to the 13th May, and 58 during the remainder of the year). For shepherds of 21 years of age and over the minimum wage is 37s. per wk. of 52 hr. in summer and 48 hr. in winter, and such additional hours as may be required for the performance

of customary duties in connection with the care of sheep (but so that the total number of hours per week shall not exceed 55 in summer and 56 in winter). Additional sums are payable in respect of work during the lambing season.

The minimum wage for male workers aged 21 years and over, employed wholly or mainly as stockmen, is 38s. per wk. of 52 hr. in summer and 48 hr. in winter, and such additional hours as may be required for the performance of customary duties in connection with the care of stock (but so that the total number of hours per week shall not exceed 56 in summer and 58 in winter). In the case of all other male workers of 21 years of age and over the minimum wage is 32s. per wk. of 48 hr. in winter and 52 hr. in summer. The overtime rates in the case of all classes of male workers of 21 years of age and over are 9½d. per hr. on week-days and 11½d. per hr. on Sundays.

The minimum rate for female workers of 17 years of age and over is 5½d. per hr. for all hours worked.

Denbigh and Flint.—An Order to operate for a period of twelve months from the 16th Feb. continuing the existing minimum and overtime rates for male and female workers unchanged. In the case of male workers of 21 years of age and over, employed wholly or mainly as teamsmen, cattlemen, cowmen, shepherds or bailiffs, the minimum rate is 37s. per wk. of 61 hr., and in that of other male workers of the same age 30s. 6d. per wk. of 60 hr., overtime in each case being at 9d. per hr. For female workers of 18 years of age and over the minimum rate is 5d. per hr. with overtime at 6¼d. per hr.

Radnor and Brecon.—An Order to operate for the twelve months commencing 15th Feb. continuing the existing minimum and overtime rates for male and female workers unchanged. For male workers of 21 years of age and over the minimum rate is 31s. per wk. of 54 hr. in summer and 48 hr. in winter, with an overtime rate of 9d. per hr. In the case of female workers of 18 years of age and over, the minimum rate is 5d. per hr. with overtime at 6¼d. per hr. on week-days and 7½d. per hr. on Sundays.

Copies of the Orders in full can be obtained on application to the Secretary of the Agricultural Wages Board.

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Leaflets issued by the Ministry.—Since the date of the list given in the August issue of the *Journal*, p. 477, the following leaflets have been issued:—

New:—

No. 123. Cultivation (and Diseases and Pests) of Cucumbers.
,, 136. Agricultural Wages in England and Wales.
,, 138. Diphtheria in Poultry (Roup or Bird Pox)
,, 139. Loganberry Cultivation.
,, 140. Poultry Manure.
,, 389. Scheme for the Distribution of Sittings of Eggs, Day-old Chicks and Ducklings of approved quality.

Re-written:—

No. 38. The Carrot Fly.
,, 92. Bunt and Smut in Wheat.
,, 303. The Turnip Gall Weevil.

Revised :—

No. 23. Potato Blight and its Prevention.
,, 94. Millepedes and Centipedes.
,, 131. Apple and Pear Scab.
,, 137. Potato Scab.
,, 146. The Value of Records of the Milk Yield of Cows.
,, 313. The Cultivation of Parsnips.
,, 400. List of Publications.

Amended :—

No. 109. Cabbage Caterpillars.

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Market for Poultry Breeding Stock in the Dutch East Indies.—The Editor of "Indisch Avicultura," a bi-monthly publication dealing with poultry in the Dutch East Indies, states that there is a large import of poultry into the country (Java, Sumatra, etc.). At present birds are supplied principally from America and Holland, but he is of opinion that, in some cases, British birds, especially Dorkings and Buff Orpingtons, would be better. Poultry breeders who may be interested should communicate with the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1, for further information.

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NOTICES OF BOOKS.

Guide to Current Official Statistics.—Vol. III.—(H.M. Stationery Office: Price 1s. net, post free 1s. 3½d.; pp. 252.) To a greater or less extent, practically all Official Publications will be found to contain statistics, but a considerable knowledge of Departmental organisation is necessary for an inquirer merely to know which annual or other periodical reports or returns are likely to provide the statistical information for which he is seeking, quite apart from the large number of special reports exhibiting the results of inquiries or researches, most of which contain statistical data. And, even so, the likely publications must be obtained and examined in order to ascertain whether any statistics that may occur in them relate to the subject of the inquiry, and, if so, whether they are analysed in precisely the required manner.

It is accordingly the aim of the Guide:—

(1) To direct the inquirer to *all* current official publications that contain statistics bearing on his subject; and especially,

(2) To inform him of the nature of the statistics he will find in the volume to which he is referred, *i.e.*, their mode of analysis, and the time and place to which they relate.

These objects are secured by means of a Subject Index (pages 12 to 184), reference from which is made by a system of serial numbers to the various volumes in a List of Publications (pages 190 to 247).

From an indexing point of view the Subject Index presents some novel features that are fully described in paras. 2 to 5 of the Introduction to the Guide. In particular, the usual difficulties of terminology in using an index, as a result of which it may appear that there are no references to the subject under consideration, are completely avoided. It is only necessary to decide to which of 25 broad headings,

e.g., Agriculture, Defence, Education, Trade, etc., an inquiry relates, and to follow up the system of successive cross-references branching from each of these headings to ascertain with certainty what (if any) statistics may be available.

Those wishing to avail themselves of the statistical material published prior to the period covered by the several issues of the Guide will find, in the Appendix to Volume Two, a broad survey of publications of permanent statistical interest issued mainly since the year 1900.

A List of British Aphides.—(J. Davidson, D.Sc., F.L.S. London: Longmans, Green & Co., price, 12s. 6d. net.) The subsidiary portion of the title of this book, viz., "Including Notes on their Synonymy, their Recorded Distribution and Food Plants in Britain, and a Food Plant Index," indicates that the work is more than a catalogue of species of aphides inhabiting Britain. Albeit, such a catalogue, straightening out as it does the synonymy of the Aphidadæ from the confusion hitherto obtaining, is a thing of no mean value in itself. This is essentially a book for the student of this group of insects and the economic entomologist, who will find this collected material brought together in a useful form indispensable for reference.

Grassland in Slovakia. Pastevnictui na Slovensku.—(Dr. Ing. Váelav Mácha: Ministry of Agriculture, Prague, price 30 crowns.) One is accustomed to regard pasture and pasture land problems as particularly associated with British agriculture, but the receipt from the Czecho-Slovakian Ministry of Agriculture of a large volume dealing with pasture in Slovakia shows that pasture may also bulk large in the rural economy of other countries. About one-eighth of the whole area of Slovakia is in pasture, in addition to about two-thirds as much meadow land for hay, and this is mostly situated in the hill regions towards the Tahas mountains where the rainfall averages about 30 inches per year. The pastures are very necessary to the agriculture of the country, especially as providing means of keeping cattle for the small-holders. For that reason a special Commission has been set up with the object of increasing the area of pasture land, and for the improvement of existing pastures and the regulation of Communal pastures to prevent their deterioration.

Particulars are given of the action taken in this direction; some ten thousand acres have been "improved" during the last five years at an average cost of about £3 an acre, and lack of funds has alone prevented a wider extension of the process. The Bulletin gives much information as to the types of land in pasture, the methods of improvement, the regulations adopted, and the live stock of the country. The main report occupies 385 pages in the Czech language, but resumés are added in English, French and German.

Publications issued by the International Institute of Agriculture. — The principal publications of the Institute are as follows:—

(1) *The International Crop Report and Agricultural Statistics.*

This Report appears monthly on the Thursday nearest to the 20th of the month. It contains information on the production, trade and prices of the principal agricultural products. This information is

supplied by the Governments of the 71 States adhering to the Institute, and relates to the area sown, crop conditions, crop forecasts and actual harvest yields, number of live stock, the import and export trade in the principal agricultural products, their prices and the amount of visible stocks.

The Report is designed to afford information as to the progress of the world's crops, trade conditions and the trend of prices of agricultural products of international importance. The products dealt with include cereals, potatoes, sugar, fibres, vegetable oils, tobacco, wine, etc.

(2) *The International Review of the Science and Practice of Agriculture.*

This Review gives information relating to progress in agricultural science and research, livestock improvement, farm engineering, rural industries, agricultural economics and plant diseases.

Part I consists of original articles by leading specialists in the various countries on the most important questions of the moment.

Part II deals with the work of International Associations.

Part III relates to the work of the Institute in connection wih international conferences, agreements, conventions, etc.

Part IV contains general information abstracted from the scientific and technical publications of the various countries.

Part V consists of current notices relating to world agricultural movements, legislative and administrative measures, agricultural institutions, congresses, exhibitions, fairs, etc.

(3) *International Review of Agricultural Economics.*

This Review deals with agricultural co-operation, agricultural insurance, agricultural credit, the economic and social conditions of the agricultural classes, land systems and other agricultural economic questions.

The Review is divided into two parts—the first containing original articles by persons who possess first-hand knowledge of the questions dealt with, or who have made a special study of them; the second consisting of notes on agricultural economic questions classified according to subject and to the country to which they relate.

International Year Book of Agricultural Statistics, 1924.—XCII + 489 pages 8vo. 8s.

The prices of the Institute's publications have been revised since the publication of the December issue of the *Journal*, and during 1926 will be as follows:—

International Crop Report and Agricultural Statistics.—Published monthly, about 50 pp. 8vo. Subscription rate for 1926, 10s.; single number, 1s. 3d.

International Review of the Science and Practice of Agriculture.—Published quarterly, about 160 pp. 8vo. Subscription rate for 1926, 12s.; single number, 3s. 6d.

International Review of Agricultural Economics.—Published quarterly, about 160 pp. 8vo. Subscription rate, 8s.; single number, 2s. 6d.

Combined subscription for the above three periodicals for 1926, 25s.

These publications are obtainable from the Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1, post free at the prices shown above. Remittances should be made payable to "The Ministry of Agriculture and Fisheries or Order" and crossed "Bank of England."

A complete list of the Institute's publications will be forwarded on application.

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

The Estate Book and Diary, 1926. (391 pp.) Letchworth: Country Gentlemen's Association, 7s. 6d. post free.

Geary, F. J.—Denmark and Ireland. Some facts for the Irish Farmer. Articles reprinted from "Irish Independent," Sept. and Oct., 1925. (110 pp.) Dublin: "Irish Independent," 1925, 6d. [63(489).]

Hitchcock, A. S.—Methods of Descriptive Systematic Botany. (216 pp.) New York: J. Wiley. London: Chapman & Hall, 1925, 12s. 6d. [58.2.]

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INDEX TO VOL. XXXII.

APRIL, 1925, TO MARCH, 1926.

NOTE.—References to Insects and Fungi are indexed under the headings "Insects" and "Fungi" only, to Weeds under the heading "Weeds" only, and to Diseases of Animals under "Diseases of Animals" only.

Editorial Notes are indexed under the subjects to which they refer.

To avoid confusion in reference the term "Ministry" is used throughout, with a very few necessary exceptions, although the word "Board" may appear in the text.

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